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STAPEL (C.). **Forsøg med Foraarskarbolineer.** [Tests with Spring Carbolineums.]—*Tidskr. Planteavl* **42** pp. 80–111, 5 figs., 2 refs.; also as *Beretn. Forsøgsv. PlKult.* no. 304. Copenhagen, 1937.

An account is given of investigations in Denmark on the use of 3 proprietary insecticidal spring carbolineums. These are liquids containing tar-oil or tar-oil and mineral oil with a soap-free emulsifier, and are known in Germany as "Baumspritzmittel" [*cf. R.A.E.*, A **24** 797, 798; **25** 4]. In contrast to the winter carbolineums, which cannot safely be used after 1st March, they can be mixed with Bordeaux mixture or lime-sulphur, and may be used in March and most of April, on apple, for example, until the buds show green at the tips. Almost all the tests were carried out on apple. Comparative counts of infested blossoms showed that the sprays were effective against *Anthonomus pomorum*, L., at concentrations of 6 and 10 per cent. when applied during the second half of April and mixed with Bordeaux (2–1–100), lime-sulphur or water. Mixed with Bordeaux, and at the same concentrations, they were applied late in April against *Psylla mali*, Schm., and subsequent counts showed that the percentage of shoots attacked was reduced to 2 or less. Early application in March was equally effective. In a laboratory test, apple-shoots infested with eggs of *Aphis pomi*, DeG., were dipped in 2 and 5 per cent. carbolineum mixtures on 20th March, and counts of the numbers of eggs that hatched showed a mortality of 85–95·5 and 98–99·5 per cent., respectively. Complete mortality of *Lecanium corni*, Bch., was caused by dipping infested shoots of currant in 5 per cent. spring carbolineums on 11th April. The three carbolineums applied on 9th March and 22nd April at concentrations of 6 and 10 per cent. and mixed with Bordeaux or water reduced infestation by *Operophtera* (*Cheimatobia*) *brumata*, L., and *Erannis* (*Hibernia*) *defoliaria*, Cl., by an average of about 83 per cent., and, at the 10 per cent. concentration, were also effective against the hibernating larvae of *Eucosma* (*Tmetocera*) *ocellana*, Schiff., and *Argyroploce* (*Olethreutes*) *variegana*, Hb., when applied on 20th and 23rd of April, shortly before the buds opened. At the same concentration and mixed with water, the 3 sprays were applied against the eggs of *Paratetranychus pilosus*, C. & F., during March and April, and subsequent counts of larvae and nymphs showed that infestation had been reduced to an average of 15, 6 and 2 per cent., respectively, of the control. The addition of Bordeaux mixture did not impair these results. The Bordeaux in all sprays was effective against *Monilia*. Sprays applied on 27th–29th April caused some scorching of the half-opened green buds of apple, but did not affect the buds of pears, though they were open at the tips. Plums should not be sprayed later than 1st April. Grass, strawberries, etc., under sprayed trees were severely scorched, but the sprays were less harmful when mixed with Bordeaux.

PRELL (H.). **Vergiftung von Schmetterlingsraupen durch Flugstaubarsen.** [The Poisoning of Lepidopterous Larvae by Air-borne Arsenic.]—*Tharandt. forstl. Jb.* **88** no. 2 pp. 126–136, 2 figs. Berlin, 1937.

An instance is recorded in which larvae of *Dasychira pudibunda*, L., that were being reared in Saxony were killed by feeding on oak foliage contaminated with arsenic from air-borne furnace gases.

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FLURY (F.). **Ueber Phosphorwasserstoff.** [On Hydrogen Phosphide.] —*Anz. Schädlingsk.* **13** no. 3 pp. 26–28. Berlin, March 1937.

Of recent years, hydrogen phosphide has been used in Germany, especially against the grain weevil [*Calandra granaria*, L.], subject to government regulations [*R.A.E.*, A **24** 476]. The author records some fatal accidents caused by this fumigant, and discusses its characteristics and the symptoms attending poisoning. Death can occur 2–3 days after a single inhalation.

ZANDER (E.). **Bienenzucht und Schädlingsbekämpfung.** [Bee-keeping and Pest Control.]—*Anz. Schädlingsk.* **13** no. 3 pp. 28–31. Berlin, March 1937.

The effect of insecticides on bees is discussed, and it is pointed out that arsenicals are the ones most likely to poison them in practice [*R.A.E.*, A **25** 211]. The danger is, however, minimised if fruit trees are not sprayed when the blossoms are open, or if the colonies are removed from an area where treatment at such a time is necessary.

ZACHER (F.). **Samenzerstörende Erzwespen.** [Seed-destroying Chalcidoids.]—*Mitt. Ges. Vorratsschutz* **13** no. 2 pp. 21–23, 4 figs. Berlin, March 1937.

This is a brief survey of the more injurious of the Chalcidoids recorded as infesting seeds, particularly those of conifers and leguminous plants, in various parts of the world.

THIEM (H.). **Vom Blattrippenstecher** (*Rhynchites pauxillus* **Germ.) als Obstbaumschädling.** [*R. pauxillus* as a Fruit-tree Pest.]—*Arb. physiol. angew. Ent. Berl.* **4** no. 1 pp. 1–17, 3 figs., 3 pp. refs. Berlin, 8th March 1937.

The author gives an account of an outbreak of *Rhynchites pauxillus*, Germ., on apple and other fruit trees near Magdeburg in 1934, and briefly summarises records of infestation in Germany and other countries, especially southern Russia, and data on the bionomics and control of the weevil from the Russian literature [*R.A.E.*, A **21** 634, etc.]. It is predominantly an eastern European species, but occasionally occurs in injurious numbers in Germany. The adults feed on and destroy the leaf and blossom buds in spring, and the females bite through the vascular bundles of the leaves in order to oviposit. The larvae feed inside the leaf-stalk, and in the mid-rib and adjoining parenchyma, and pupate in the soil when the fallen leaves containing them have rotted. The larvae in the leaf-mines are killed if the weather is hot and dry for some time. In June–July 1934, the outbreak near Magdeburg was ended in this manner, the average daily temperatures from 13th June to 2nd July being 19·8°C. [67·64°F.] and the total rainfall 30·6 mm. Effective control can be obtained by burning the leaves that have fallen or have been shaken from the trees, before they have time to decay. Trees heavily infested by the adults should be sprayed with nicotine (0·15 per cent.) in soap solution just before blossoming. If necessary, the spray should be repeated as soon as the blossoms fall. It is best applied in warm, sunny weather, as the weevils are then on the young shoots. If the weather is cool, the trunks and branches should also be sprayed.

MAERCKS (H.). **Ueber die Sicherheit der Vorraussage von Schlupfterminen bei Schadinsekten.** [On the Reliability of Forecasts of the Date of Emergence of Insect Pests.]—*Arb. physiol. angew. Ent. Berl.* **4** no. 1 pp. 17–30, 3 graphs, 13 refs. Berlin, 8th March 1937.

The successful control of an insect pest often depends on a knowledge of the earliest date of appearance of a given stage. On the basis of the relation between temperature and duration of development, the latter is often calculated in practice by means of Blunck's hyperbolic equation [*R.A.E.*, A **13** 389], although it is known that it can be used only in certain temperature zones. Janisch's catenary curve [**21** 378] expresses the relation more perfectly.

In the hyperbola, the constants can be determined from any two points of the curve, and it was believed that observations of temperature at two random points would be sufficient for approximate calculation of the development times at the other temperatures. In the symmetrical form of the catenary curve, it is necessary to have one random point and one definite point, the minimum time of development. To ascertain this minimum point by inter- and extrapolation, observations must be extended to three different temperatures. Owing to the additional observation thereby entailed, there was an inducement to prefer the hyperbolic curve, which often gave sufficient accuracy in practice. It was therefore assumed that the hyperbolic formula would permit forecasts at temperatures outside the temperature zones investigated. Where many records exist, including some at low temperatures, they often produce a sufficiently accurate hyperbola, but it is evident that where abundant data are available, calculation is superfluous. In general, observations at low temperatures are scanty, so that it is necessary to calculate, from a few data at medium and high temperatures, the development durations for temperatures outside the temperature zone investigated, and to use a curve that gives fairly accurate results for low temperatures, such as occur in spring and autumn. The author discusses the extent to which the hyperbola and the catenary curve (symmetrical or asymmetrical) satisfy these requirements.

He concludes that, to avoid error with the hyperbola, it is necessary to base the calculation, when forecasting for low temperatures, on empirical data obtained at room temperature and at a temperature high enough to cause a retardation in development ; when forecasting for medium temperatures, the experimental data must be obtained at room temperature and at a temperature near the minimum of the temperature curve for duration of development. It is only when the curve is flat that the hyperbola calculated in the zone of temperatures occurring in practice does not differ greatly from the curve of average values. Even so, at least three observations are needed to decide if the curve is flat or steep.

The catenary curve gives a good agreement with observed data, whether the curves are flat or steep and temperatures are low, medium or high. The calculation is always made with the minimum and with the development time ascertained for any other random temperature. The minimum is obtained from an empirical curve resembling a catenary curve and joining up any three ascertained temperatures. As, therefore, the hyperbola does not involve less experimental data, the catenary curve is to be preferred, because it is more accurate.

HAMPP (H.). **Erdfloh-Bekämpfungsversuche bei Hopfen auf dem Hopfenversuchsgut in Hüll 1927 bis 1936.** [Experiments in combating Hop Flea-Beetles from 1927 to 1936 on Hops at the Hop Experiment Station at Hüll.]—*NachrBl. dtsch. PflSchDienst* **17** no. 3 pp. 21–23. Berlin, March 1937.

Flea-beetles of the genera *Chaetocnema*, *Psylliodes* and *Haltica* are among the worst pests of hops in Bavaria, especially in warm, sunny situations. In spring the injury to the shoots, which is usually most severe in May, retards their growth, weakens the plants and reduces the crop. The second, summer, attack impairs the appearance and quality of the inflorescences. The beetles were particularly abundant in 1928, 1934, which was extremely dry and hot, and 1935. Some varieties of hops are more attacked than others; those that grow rapidly when young overcome the effect of the injury most readily. Since 1926, 45 different insecticides have been tested in 31 experiments. Hand dusters and knapsack sprayers were used. On an average, 60 minutes were required to dust 7,000 hop vines and 70 minutes to spray them with 22 gals. of spray. The effect was best judged after an interval of 72 hours. In the dusting tests, derris insecticides invariably proved absolutely reliable and were distinguished by rapid and effective action. Pyrethrum was always less efficient, and though good results were obtained with 22 lb. per 1,000 vines, it is not advocated. Nicotine acted quickly, but required a high air humidity, and many beetles recovered. Arsenicals acted slowly, but were effective if the weather was continuously fine. The silicic acid powder, Naaki [*cf. R.A.E.*, A **24** 341, 814], was merely a repellent. In the spraying tests, derris and nicotine had good killing power, while that of pyrethrum was poor. Dusts, however, are more satisfactory, prompt application being essential.

DAVIES (W. M.). **Aphis Migration and Distribution in Relation to Seed Potato Production.**—*Sci. Hort.* **5** pp. 47–54, 10 refs. Wye, Kent, February 1937.

In this paper, previous work on the distribution and migration in relation to climatic factors of various Aphids transmitting virus diseases of potatoes in Wales, of which the most important is *Myzus persicae*, Sulz., is discussed in some detail [*cf. R.A.E.*, A **24** 551, etc.]. Studies with a mechanical trap [**24** 112] have shown that the frequency of a favourable combination of meteorological factors will greatly influence the intensity of the initial population of Aphids on summer food-plants and will also determine the intensity of the migration to the winter food-plants. Thus spring infestation on fruit and rose trees is markedly affected by the meteorological conditions prevailing during the previous September and October, when sexual forms are migrating. The winged forms of all species of Aphids react similarly to the meteorological factors under consideration. Under favourable conditions, migrating winged Aphids find their food-plants with remarkable ease. In 1935, in different districts, 100 single potato tubers were planted 10 and 20 yards apart in fields of mangels. At 3 such centres, over 90 per cent. of these isolated plants were infested with *Myzus persicae* before they were 6 inches high, 5 or 6 winged individuals often occurring on one plant. Failure to find the food-plant, therefore, seldom appears to be a factor affecting colonisation.

This was confirmed by the fact that *Idiopterus nephrolepidis*, Davis, a foreign species confined to glasshouses, was recently observed colonising small ferns well inside a cave. The nearest glasshouses were over a mile away, and the Aphid was not found there.

These investigations, supplemented by a survey in Scotland, indicate that no district in Great Britain where potatoes can be grown on any appreciable scale is free from Aphids, including *M. persicae*. There are, however, areas where the infestation is so low that seed potatoes have been grown successfully for a number of years, and it is recommended that such areas should be used for the propagation of healthy stocks of these and other crops liable to virus diseases transmitted by Aphids.

The Chrysanthemum Midge.—*J. Minist. Agric.* **43** no. 12 pp. 1158–1161, 2 pls. London, March 1937.

The species of *Diarthronomyia* that is a serious pest of greenhouse chrysanthemums in the United States, causing galls on the leaves, stems and buds, is usually considered to be *D. hypogaea*, Lw., a European species that infests the roots of the wild ox-eye daisy [*Chrysanthemum leucanthemum*]. The difference in habits suggests, however, that the two Cecidomyiids are distinct species, and in any case the American form must be regarded as distinct from the horticultural point of view, and every effort should be made to prevent its establishment in Britain. It was recorded in England, in each case originating from chrysanthemums imported from the United States, in 1927 [*cf.* **16** 10; **18** 330] and 1936, and was found in Denmark [**24** 55] in 1934.

The eggs are laid in groups on the growing parts of the plants, usually on the small hairs of the developing leaves, and hatch in 4–12 days. The larvae burrow into the tissues of the plant, where they cause characteristic cone-shaped galls, particularly on the upper surface of the leaves. In severe infestations, the stems, buds and developing flowers are also affected, and the plants are stunted and distorted. Larval development requires 3–4 weeks in spring and autumn, but is retarded in winter and summer. The pupal stage is passed in the galls and lasts about 10 days. The adults usually emerge between midnight and 5 a.m. and do not live for more than 2 days. A female lays 80–150 eggs. Breeding is continuous throughout the year, but the periods of maximum activity occur when cuttings are being taken and rooted in the spring, and when the flowers are developing in the autumn.

Methods of control in the United States include frequent spraying with nicotine against the adults and eggs [**17** 406], and nightly fumigation with hydrocyanic gas or nicotine to kill the females before oviposition. As the midge is not yet established in England, any outbreak should be notified to the Ministry of Agriculture, which has power to deal with outbreaks under the Destructive Insects and Pests Order of 1933. The general nature of the measures enjoined for its eradication are as follows: In nurseries where ordinary commercial varieties are grown for the flower, all leaves with galls must be removed and burnt, no flowers with galls on the leaves or stems may be marketed, and all plants must be destroyed by fire after flowering. No cuttings may be taken, and, after all plant refuse has been removed, the houses must be left vacant for at least 14 days. In nurseries where new or valuable varieties are grown, infested leaves must be burnt and no flowers with galls may be marketed. Spraying with nicotine shall be

carried out twice weekly in the spring and autumn. After flowering, all tops must be cut down and burnt, cuttings must not be taken from heavily infested plants, and none showing galls may be rooted. Before planting, all cuttings must be dipped in the nicotine wash. No cuttings or stools shall be distributed from the nursery except by permission of an Inspector.

KENNEDY (J. S.). **The Humidity Reactions of the African Migratory Locust,** *Locusta migratoria migratorioides* **R. & F., Gregarious Phase.**—*J. exp. Biol.* **14** no. 2 pp. 187–197, 4 figs., 13 refs. London, April 1937.

The following is the author's summary: Under the conditions of the experiments described, *Locusta migratoria migratorioides*, R. & F., shows a preference for dry air in all parts of the humidity range, although dry air is by no means optimal for development, maturation, and breeding. The strength of the reaction is correlated with the magnitude of the humidity difference available, but appears to be little dependent on the region of the humidity range. The mechanism of the reaction is hygrokinetic and possibly hygrophobotactic as well, but probably not hygrotropotactic.

RAMCHANDRA RAO (Y.). **A Report on the Work done by the Research Staff under the Locust Research Entomologist to the Imperial Council of Agricultural Research at Karachi during the year 1936.**—Med. 8vo, 161 pp. Simla, 1937.

An account is given of field studies on *Schistocerca gregaria*, Forsk., phase *solitaria*, which were continued in 1936 in British Baluchistan and the Sind-Rajputana desert [*cf. R.A.E.*, A **24** 443], and the distribution and breeding of the locust are discussed and correlated with meteorological data. The changes in population densities in these areas have again confirmed the view that seasonal migrations are undertaken by individuals of the solitary phase. A rough correspondence between the forms produced in spring in Mekran, which have ratios approaching the gregarious phase and six eye-stripes, and those found in early summer in the Sind-Rajputana desert offers further evidence of such a migration; this is again confirmed by the resemblance between the forms produced in Rajputana, which approach the solitary phase and have seven eye-stripes, and the forms found at the beginning of winter in Mekran. The presence on locusts found in a dry locality of the larvae of the red mite, *Trombidium grandissimum*, Koch, which are known to develop after good rains, suggests migration from an area where rains have recently fallen. A mauve colouration of the hind wings in locusts caught in the field was taken to indicate active migration in bright sunlight, for this colour developed on the wings of newly moulted adults that had had their elytra removed and were kept exposed to sunlight.

Experimental work on *Schistocerca* on the lines described in the previous report [*loc. cit.*] was continued, and the results confirmed earlier findings. Larval development was accelerated by diets of *Sorghum* seedlings and fresh *Heliotropium undulatum*. Hoppers reared in yellow, black, dark green and white boxes tended to assume the colour of the background. The study of striped eyes was continued by Roonwal [**24** 634], who found that one stripe is added during each

larval instar; in the case of seven-striped eyes, two stripes are added during the third instar. Observations by other workers indicate that there is a correspondence between the number of stripes and the number of moults, the forms with seven stripes undergoing an extra moult.

The report is concluded by a general survey of the results of locust research in India during the years 1931–36 [*cf.* **22** 121; **24** 443; **25** 161], and includes numerous tables of results of experimental work, as well as some showing the relation between the amount of rainfall and breeding in 1931–36, the meteorological data obtained during ecological work and statements of expenditure on research.

BALLARD (E.). **Report of the Government Entomologist.**—*Rep. Dep. Agric. For. Palestine 1934–35* pp. 178–180. Jerusalem, 1936.

In the year ending March 1935, infestation of *Citrus* in Palestine by *Chrysomphalus ficus*, Ashm., was very light in most groves, both in the Jaffa area and in the Acre sub-district. As a result of investigations into the biology of the scale [*R.A.E.*, A **25** 257], it was found that winter fumigation would be best throughout the orange-growing area, but that the normal winter climate would prevent this everywhere except in the neighbourhood of Lake Tiberias. An increasing number of groves infested with red scale [*Aonidiella aurantii*, Mask.] have been sprayed, and about 25,000 trees have been fumigated. *Lepidosaphes beckii*, Newm., was much more widely distributed than previously, but, except in one case, infestation was nowhere severe. Widespread infestation of *Citrus* by *Ceratitis capitata*, Wied., resulted in considerable damage. In one locality, 75 per cent. of the late crop was saved by the use of bait-traps. Larvae of this fruit-fly were also found in walnuts. Apples were attacked by *Zeuzera pyrina*, L., and *Eriosoma lanigerum*, Hsm., and, where control measures were not in use, 60 per cent. of the crop was infested by *Cydia pomonella*, L., and was unfit for marketing.

BRIXHE (A.). **Le Dysdercus, ravageur du cotonnier.**—*Bull. agric. Congo belge* **27** no. 4 pp. 625–647, 9 figs., 35 refs. Brussels, December 1936.

The distribution, bionomics and control of *Dysdercus* spp., and the damage they cause to cotton are discussed from the literature, with special reference to conditions in the Belgian Congo, where the most abundant species are *D. superstitiosus*, F., and *D. melanoderes*, Karsch, in the north, and *D. nigrofasciatus*, Stål, in the south.

[KOSOBUTZKIĬ (M. I.).] **Кособуцкий (М. И.). Test of the diluted Sulphur Preparations of the "Ultra-sulphur" Type for the Control of the Red Spider** (*Epitetranychus althaeae*). [*In Russian.*]—*Plant Prot.* 1936 fasc. 9 pp. 5–22. Leningrad, 1936. (With a Summary in English.)

The value of different sulphur dusts and a lime-sulphur spray (0·75°Bé) against the red spider on cotton, which is here regarded as *Tetranychus telarius*, L. (*Epitetranychus althaeae*, v. Hanst.) [*cf. R.A.E.*, A **25** 146], was tested in field experiments in July 1935 in Khiva. The contents of pure sulphur in the dusts varied from 13 to

35·8 per cent. They were applied at rates of from 32 to 108 lb. per acre on the second or third day after the plants had been watered, and the spray was used at a rate of 133 gals. to the acre. The results showed that preparations of finely divided sulphur in combination with marl or phosphorite (calcium phosphate), ferro-sulphur (from pyrites slag), and mechanical mixtures of sulphur with lime in proportions varying from 1 : 1 to 1 : 9 were practically equivalent in effectiveness to pure ground sulphur at the same rate of application (32 lb. per acre). The radius of the action of the particles of sulphur is apparently small, and the effectiveness of the dust depends not only on the quantity applied but also on the evenness of distribution. Unsatisfactory methods of application may explain the view that sulphur is of little value for dusting cotton [*cf.* **22** 440]. In the author's experiments, the treated colonies of mites were completely eliminated; though the eggs were not affected by the dusts, the young larvae died as soon as they hatched. The effect of dusting lasted a long time; after 40 days the number of active colonies on the treated plants was only a quarter of that on the control. The lime-sulphur spray, acting by contact, destroyed all stages of the mite, including the eggs, but the solution soon dried up and ceased to be effective, so that the sprayed plants became reinfested. Tests of the existing dusting machinery showed that it is not satisfactory for treating cotton, and a complete covering of the leaf surface can only be secured if a considerably larger amount of the dust is used than would be necessary if distribution were perfectly even. A certain amount of the dust is carried away by air currents, particularly if the plants are at a distance from one another and the air is hot. From calculations of the gradual increase of the leaf surface of cotton plants during the season, the author suggests that the quantity of dust required per acre would rise from 32–40 lb. in May–June to 90 lb. in August–September. The dark coloured dusts, such as ferro-sulphur or the dust prepared with ground phosphorite, cause the plants to be withered for a considerable time, probably owing to increased heating of the leaves and the resultant increased transpiration. On the other hand, greater heat increases the effectiveness of the preparations.

[Chugunin (Ya. V.).] **Чугунин (Я. В.). Investigations on Oil-clay Emulsions.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 9 pp. 23–26, 3 refs. Leningrad, 1936. (With a Summary in English.)

In view of the fact that mineral oil emulsions prepared with such emulsifiers as soft soap, naphthene soap or hydrated ferrous sulphate are quick-breaking and often cause severe scorching of the trees, they are very little used in the Crimea against Coccids on apples and pears, with the result that the trees are heavily infested. Experiments were therefore carried out in the summer of 1935 and in January–February 1936 in which different clay dusts were used as emulsifiers for solar oil. A very effective miscible oil was obtained by thoroughly mixing 2–3 parts clay powder with 7–8 parts oil, and a paste by using 3 parts clay to 2 parts oil. When these mixtures were diluted, the oil droplets in the resulting emulsions were very large, but this appeared to increase their effectiveness, since spraying with an emulsion made of solar oil and soft soap at an oil concentration of 6 per cent. only killed 38·5 per cent. of the eggs of Psyllids on pear,

as compared with 67·5 and 76·6 per cent. killed by emulsions from oil-clay paste at concentrations of 3·5 and 5·25 per cent., respectively. Moreover, no injury to the trees was observed. In the case of the miscible oil, it was necessary to mix the clay with the oil at rates of 3 : 7 or 4 : 6 to avoid risk of scorching. No severe injury was obtained when cut branches of apple, which developed in the laboratory in February, were sprayed at the moment of the opening of the buds with an emulsion prepared with clay and used at 3–5 per cent. strength, whereas the young leaves and buds were seriously injured by a 3 per cent. oil spray in which soft soap was the emulsifier. Applied in December as dormant sprays at 4 per cent. strength, the emulsions killed 98·3 per cent. of *Lecanium corni*, Bch. Investigations on the way in which the clays decreased the injurious effect of the solar oil on plants showed that they reduce the acidity of the oil by about 7 times, and probably remove the injurious components from it. Moreover, the oil-clay emulsions never showed reversibility of the phases, as sometimes do the emulsions previously used.

[Meĭsakhovich (Ya. A.).] **Мейсахович (Я. А.). The Scale of Spray Dispersion.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 9 pp. 32–37, 1 pl. Leningrad, 1936. (With a Summary in English.)

In order to make it possible to determine easily the quality of dispersion of a spray given by different types of sprayers, 15 illustrations are given of the deposits obtained with sprays of 5 different degrees of fineness, each at 3 degrees of dispersion. Each illustration is supplied with a legend giving the following particulars : the amount of liquid required per hectare of a flat surface ; the percentage of the surface covered with the spray ; the number of drops per sq. cm. ; and the average diameter of the drops. To determine the quality of a spray, a sample of the deposit obtained on a glass plate or on a leaf is compared with the corresponding illustration in the scale.

[Belizin (A.).] **Белизин (А.). Influence of Vernalization on the comparative infestation of Cereals with Insect Pests.** [*In Russian.*] —*Plant Prot.* 1936 fasc. 9 pp. 54–67, 9 graphs. Leningrad, 1936. (With a Summary in English.)

The investigations described were carried out in the summer of 1935 in the district of Odessa on plots in which varieties of summer and winter wheat and barley were grown from vernalised and non-vernalised seeds. The only insect pests of any importance in the plots were *Mayetiola destructor*, Say, *Oscinella* (*Oscinosoma*) *frit*, L., *Haplothrips tritici*, Kurdj., and the leaf Aphids, *Toxoptera graminum*, Rond., and *Brachycolus noxius*, Mordv. Repeated examinations of the plants at different stages of development showed that the vernalised crops were definitely less injured than the others.

M. destructor chiefly attacked the secondary shoots of the vernalised wheat, since the main stalks were already too coarse for oviposition at the time of mass flight. The destruction of the secondary stalks by the larvae induced vigorous growth of the main stalks and resulted in an increase of the crop. Barley was little infested. *O. frit* occurred in small numbers only, but infestation by it was heavier in non-vernalised plants. The leaf Aphids only occurred in small colonies on the leaves and stalks of vernalised wheat and barley and did not

prevent the formation of the ears, whereas they were numerous on the non-vernalised plants and the ears were eventually only partly formed. Unlike other pests, *H. tritici* infested a greater percentage of the stems of certain varieties of wheat and barley in the vernalised sowings. In most cases, however, only one thrips occurred per stem and the infested plants were not affected, whereas deformation of the ears was caused in the non-vernalised ones.

It is concluded that vernalised plants are more resistant to pests, because their germination and development are accelerated and their growth is more vigorous.

[Printz (Ya. I.) & Gutieva (F. P.).] **Принц (Я. И.) и Гутиева (Ф. П.). Die Anwendung von** *Trichogramma evanescens* **gegen** *Polychrosis botrana.* [The Application of *T. evanescens* against *P. botrana.*] [*In Russian.*]—*Plant Prot.* 1936 fasc. 9 pp. 76–82, 1 fig., 1 graph. Leningrad, 1936. (With a Summary in German.)

An account is given of experiments in 1934 in Central Georgia in which *Trichogramma evanescens*, Westw., was reared on eggs of *Sitotroga cerealella*, Ol., and released for the control of the third generation of *Polychrosis botrana*, Schiff., on vines. The rearing technique is described. The releases were begun on 10th August, when cards bearing parasitised eggs of *Sitotroga* were tied to the vine bushes; in 3–4 days, however, all the eggs were destroyed by ants. On 18th and 22nd August further lots of cards, with a total of 35,000 eggs, were suspended on wires fixed between individual bushes, at the rate of 1 card (bearing 1,000 eggs) to each 100 bushes. Examination in late August and early September showed that from 7·6 to 75 per cent. of the eggs of the vine moth per bush were parasitised, the rate of parasitism being highest where the eggs on the bunches of grapes were most numerous. The radius of action of the parasite did not, however, extend further than 32 ft. from the point of release.

[Pyatnitzkiĭ (G. K.) & Klishevich (N. V.).] **Пятницкий (Г. К.) и Клишевич (Н. В.). On the Methods of forecasting Mass Outbreaks of** *Euxoa segetum* **Schiff.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 9 pp. 83–91, 14 refs. Leningrad, 1936.

In view of divergent opinions as to the effect of temperature and rainfall on the abundance of *Euxoa segetum*, Schiff. [*cf. R.A.E.*, A **14** 605; **17** 593; **20** 229], the authors review statistical data obtained from a number of meteorological stations in European Russia for the years 1893–1901, 1911–1915 and 1920–1930, and briefly analyse the weather conditions that have accompanied outbreaks of the moth. The results indicate that in the northern zone of its distribution the amount of rain in July does not exercise any appreciable influence on outbreaks, which usually occur if the temperature in that month is 15·7–17·7°C. [60·26–63·86°F.]. In the south, outbreaks are favoured by temperatures in May–June varying from 14·8 to 17·3°C. [58·64–63·14°F.] and over 50 mm. [2 ins.] of rainfall. They appear to be checked if the temperature in May–June is above 18°C. [64·4°F.] and the rainfall below 50 mm. In most cases, the year preceding the outbreak was characterised by temperatures in May–June lower than those of the year before, or of the year of the outbreak.

The authors consider that the causes of outbreaks of an insect cannot be definitely determined by comparing the mean monthly

temperatures and average amounts of precipitation for a series of years. They believe that the effect of meteorological factors on such outbreaks is chiefly due to the influence of extreme fluctuations of these factors on certain most susceptible stages of the insect, which are usually of a very short duration. These extreme fluctuations, however, are not evident from average monthly temperatures and precipitation.

[Tziopkalo (V. L.).] **Циопкало (В. Л.). The Control of Cockchafers by Means of dusting of Food Trees.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 9 pp. 92–110. 1 fig., 3 graphs, 26 refs. Leningrad, 1936. (With a Summary in English.)

To test the correctness of the view that poisonous dusts are of no value against adult Melolonthids [*cf. R.A.E.*, **14** 505; **15** 277, 674; **17** 10], experiments with *Melolontha hippocastani*, F., were carried out in the Ukraine in insectaries on the edge of a forest, where conditions of temperature and humidity were as near the natural ones as possible. The dusts were applied to the leaves of oak branches, which were stood in jars of water. The beetles did not refuse to eat the poisoned leaves, and the fact that they consumed only a third of the amount eaten by control beetles may be explained by the effect of the poison on them. The males were much less resistant to the poisons than the females. Calcium arsenite and Paris green both killed all the males when applied twice at rates equivalent to 11·7 lb. per acre. Sodium fluosilicate killed 86 per cent. at the same rate of application. Sodium fluoride and calcium arsenate required a much higher rate, but gave 100 and 76 per cent. mortality when the rate was 31·5 lb. In the case of females, a satisfactory mortality was only obtained with large quantities of dust, 86, 79 and 59 per cent. being killed by sodium fluoride, sodium fluosilicate and Paris green, respectively, at the rate of 31·5 lb. per acre, and 79 per cent. by calcium arsenite at the rate of 18 lb. Calcium arsenate produced a low mortality, and barium fluosilicate was ineffective. All the insecticides tested acted slowly, the poisoned males and females living for averages of 4·5 and 6 days, respectively. Dissection of females that had survived for a week on treated foliage showed no evidence that arsenic affects the development of the eggs in them.

In the Ukraine, the mass flight of the beetles occurs in April or May, and the females feed for 10–15 days before ovipositing. They emerge 6–7 days after the first males, and dusting should begin at this time. It would only be feasible in pine forests growing on dry sandy soil, where deciduous undergrowth is usually absent and the beetles have to feed chiefly on oaks confined to comparatively small plots, which could be treated from aeroplanes.

[Lebedyanskaya (M. G.), Medvedeva (V. I.) & Chernopanevkina (S. M.).] **Лебедянская (М. Г.), Медведева (В. И.) и Чернопаневкина (С. М.). *Trichogramma evanescens* and its possible Use in the Control of Insect Pests.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 9 pp. 111–123. Leningrad, 1936.

A severe outbreak of *Loxostege sticticalis*, L., was expected in the Ramon district of the central black-soil zone in 1932, since up to 1,700 eggs per sq. yard were laid in beet fields in the second half of June. A week or 10 days after the beginning of oviposition, however,

80–100 per cent. of the eggs were found to be parasitised by *Trichogramma evanescens*, Westw., and the outbreak did not occur. In other districts the rate of parasitism varied from 23 to 82 per cent. Investigations were therefore begun in August on the possibility of breeding and utilising the parasite. As breeding material, the eggs of the Lymantriid, *Dasychira pudibunda*, L., were chiefly used, and to a less extent those of the Noctuids, *Euxoa segetum*, Schiff., and *Barathra brassicae*, L., as well as a few of *L. sticticalis*. At a mean temperature of 22–25°C. [71·6–77°F.], the parasite completed its development in 8–9 days in the eggs of the Noctuids and in 10–13 in those of *Dasychira*. The average number of eggs laid by a female was 44 in August–October 1932 and 36·5 in June 1933. Most of the eggs were laid during the first 2 days of the oviposition period, which usually lasted up to 6 days. The number of eggs deposited in one egg of the host depended on its size, 1–2, 1–4 and 1–15 adult parasites emerging from single eggs of *L. sticticalis*, *E. segetum* and *D. pudibunda*, respectively. The newly emerged parasites did not differ much in size, irrespective of how many had developed in one host egg. The average sex ratio of the parasite was 1 male to 2·1 females ; in the case of parthenogenetic reproduction, only males were obtained.

An attempt was made in 1933 to control *L. sticticalis* by placing batches of parasitised eggs of *D. pudibunda*, which should have given rise to a total of 100,000 *Trichogramma*, in an infested beet field on 27th June. Parasites, however, were not found when the field was examined on 15th July, nor were parasitised eggs of any insects. The failure was probably due to rainy weather, and to the fact that a considerable percentage of the eggs of the moth had already hatched.

Experiments were also carried out to ascertain the period during which parasitised eggs can be stored at low temperatures. Those used were chiefly eggs of *D. pudibunda* kept at 0–6°C. [32–42·8°F.] and then transferred at various dates to an incubator for the parasites to emerge. Parasites emerged from 83·7 per cent. of the eggs stored for 4 months and from 13–62 per cent. of those stored for 7–8 months, but from few or none of those stored longer. Since the eggs and young larvae of the parasite are the least resistant stages, the best time for placing the host eggs in cold storage would be 4–5 days after parasitism, when the larvae are half-grown.

In preliminary cold-hardiness tests, *Trichogramma* in host eggs was not affected by remaining under snow for 7 days at temperatures as low as −11°C. [12·2°F.], and the adults were not killed by exposure for 24 hours to temperatures not lower than −6·5°C. [20·3°F.], but did not survive exposure to −20°C. [−4°F.].

D. pudibunda was very abundant in oak forests situated between the towns of Ramon and Voronezh ; it has one generation a year, the pupae hibernating in the forest litter. It was easily reared, and the females matured from 45 to 780 eggs. Only about 40 per cent. of these were laid, but the others were successfully used as hosts for *Trichogramma* after being extracted, washed and dried.

[Grankina (K.).] **Гранкина (К.). Washing of the Soil as a Method for recording small Soil Insects.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 9 p. 124–125. Leningrad, 1936.

To determine the abundance of hemp flea-beetles [*Psylliodes attenuata*, Koch] in fields of hemp, samples of soil are usually dried,

the lumps of earth broken by hand, and the beetles removed and counted. This method is, however, inaccurate and very laborious. It is suggested, therefore, that the sample of soil (a 2-inch layer from 3 sq. ft.) should be mixed with about $2\frac{3}{4}$ gals. water. Some of the flea-beetles rise to the surface immediately, and others will do so as the soil is stirred at intervals. The whole process takes 20–25 minutes if there are not more than 50 beetles in the sample, or 40–45 minutes if there are 100–150.

[Konakov (N.) & Onisimova (Z.).] **Конаков (Н.) и Онисимова (З.). An Apparatus for recording the Insect Fauna of the Grass-cover.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 9 pp. 125–127, 10 refs. Leningrad, 1936.

A description is given of an apparatus devised for estimating the numbers of insects occurring on soil and low growing vegetation. It consists of a sheet iron frame, 20 ins. square and 4 ins. high, with the lower edge sharp and the upper edge bent outwards so that a fabric cylinder can be attached to it by elastic. The cylinder is about $5\frac{1}{2}$ ft. long ; the lower half is made of white calico and the upper half of white muslin. It can be closed in the middle and at the top by string or elastic. The frame, with the cylinder closed in the middle, is thrown on to the selected patch of ground and pressed into the soil by means of handles on the sides. The operator then passes his head and arms into the upper part of the cylinder, and an assistant ties it round his body. After this, the middle of the cylinder is opened so that he obtains free access to the vegetation on the plot. He should be equipped with the necessary instruments for collecting small insects, etc. His clothes are examined for insects by the assistant through the muslin before he leaves the cylinder.

[Doĭnikov (A.).] **Дойников (А.). Agrotechnical Measures in Codling Moth Control.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 9 pp. 128–129. Leningrad, 1936.

In the course of investigations on the codling moth [*Cydia pomonella*, L.] in the environs of Astrakhan, it was found that the infestation of apples of the same varieties varied greatly in neighbouring orchards. This was believed to be due to the different combinations in which various fruit trees were planted, so that some of them offered favourable conditions for the moth and others did not. It has three generations a year, of which the first develops mainly in the summer varieties of apples and to a less extent in quinces, pears and apricots, the second mainly in autumn and winter varieties of apples and partly in summer ones, pears and quinces, and the third almost exclusively in quinces and only to a small extent in winter apples that are still present on the trees. At the time of the quince harvest (October), most of the larvae have spun cocoons on the stems of the quinces, as many as 100 occurring on a tree. Thus, quince trees are the real focus of the overwintering generation, and summer apples near them are heavily infested.

It is therefore recommended that wherever the codling moth produces 2 or 3 generations a year, early maturing varieties of fruit trees should not be grown close to late varieties or to quince. The minimum distance required between the trees has not yet been ascertained, but

it has been found that early varieties are much less infested if they are some 220 yards away from the late ones. The space between the trees may be used for cherries or bush-fruits, which are not attacked.

[Kharitonov (Ya. N.).] **Харитонов (Я. Н.). Use and Estimation of agrotechnical Methods of Controlling** *Agrotis segetum* **under the Conditions of the Gorky Region.** [*In Russian.*]—Abstr. in *Plant Prot.* 1936 fasc. 9 p. 140. Leningrad, 1936. **The Estimation of the Chemical and Mechanical Methods of controlling** *Agrotis segetum.* [*In Russian.*]—Abstr. *T.c.* p. 141.

Experiments against *Euxoa* (*Agrotis*) *segetum*, Schiff., carried out in the Gor'kiĭ Region (former Department of Nizhniĭ-Novgorod) in 1934 showed that the sowing of vetch and oats in fallow land, and deep ploughing of the unoccupied fallow at the time of the mass oviposition of the moths will reduce infestation by 93–94 per cent. Harrowing at that period will reduce infestation by 87 per cent., but only by 50 per cent. if it is carried out a week later. Deep ploughing at the time of the hatching of the eggs will reduce the infestation of the fallow by 74 per cent. All these measures are of value only if the weeds are destroyed.

Poison baits were most effective when applied in fallow land after it had been ploughed for autumn-sown crops and before the latter had sprouted. If applied when the plants had already formed tufts, the baits were practically ignored by the larvae. The presence of weeds also decreased their effectiveness.

[Belyaev (I. M.) & Kharchenko (V. V.).] **Беляев (И. М.) и Харченко (В. В.). Characters of Cereals indicating their Resistance against Infestation by** *Oscinosoma frit* **L.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 10 pp. 50–60, 5 figs. Leningrad, 1936. (With a Summary in English.)

On the basis of investigations in Moscow, the authors discuss the factors concerned in variations in the resistance of cereals, chiefly wheat, to *Oscinella* (*Oscinosoma*) *frit*, L. The selection of a resistant variety appears to be a reliable means for safeguarding the crop. The plants may be resistant either to the injury caused or to the infestation itself. The rapidity and extent of recovery from the injury depends on the phase of the development in which the plant is attacked, the density of tillering and the type and quality of manure. Of plants of which the main stem is attacked, the percentages that die are 27–63, 15–34 and 3–15 if infested at the phases of 2, 3 and 4 leaves, respectively. The factors concerned in resistance to infestation itself include a coleoptile that fits closely to the stem, long and dense hairs on the leaf-sheath and leaf-blade, which prevent oviposition, and rapid growth and development of the stems. Varieties of cereals with long leaf-sheaths are also less attacked, as the stems do not trail and are taller and thus less attractive to the flies. Moreover, the leaf-sheaths are definitely ribbed in resistant varieties and practically smooth in susceptible ones. Coarseness of the young stems is a decisive factor in the resistance of varieties that are smooth or only slightly covered with short hair. The study of the anatomical structure of the

leaf-sheaths showed that the cells in resistant varieties are comparatively small, the external membrane of the epidermis cells is thick and the sclerenchyma is vigorously developed.

[Stepantzev (I. N.).] **Степанцев (И. Н.). The Curves of Effectiveness of the agricultural Pests Control and their Interpolation.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 10 pp. 61–68, 5 figs., 1 ref. Leningrad, 1936.

If the percentage mortality of an insect pest caused by one application of an insecticide increases gradually over a considerable period, it may be impossible or useless to determine its total effectiveness. It is then more important to determine the character of the increase in mortality in the first days after treatment and estimate the final effect from this. It may thus be shown that further treatments are required, before it is too late to apply them. To make the estimate, it is necessary to find an equation from which a mortality curve can be obtained to correspond with that based on observed mortality. It is then possible to estimate the subsequent effectiveness of the treatment by extrapolation and its effectiveness at any given moment in the period of observations by intrapolation. The author sets out the complicated technique of making the necessary calculations and constructing the curves on the basis of an example taken from actual experience.

[Mordvilko (A. K.).] **Мордвилко (А. К.). The Black Bean or Beet Aphis**—*Aphis fabae* **Scopoli** (*Aphis evonymi* **Fabr. part.**, *A. papaveris* **Fabr.**, *A. rumicis* **L. Börn. part.**, *A. philadelphi* **Börn.**, *A. mordvilkoi* **Börn. et Jan.**). [*In Russian.*]—*Plant Prot.* 1936 fasc. 10 pp. 69–72, 15 refs. Leningrad, 1936. *Eriosoma lanuginosum* **Hart.** [*In Russian.*]—*T.c.* pp. 73–74, 5 refs.

The first paper comprises a general discussion, largely from the literature, of the life-cycle, food-plants and synonymy of the Aphid that is injurious to beet in the south of European Russia and elsewhere, which the author considers to be *Aphis fabae*, Scop.

In the second paper, it is recorded that a few alate adults of the woolly pear Aphid, *Eriosoma lanuginosum*, Htg., which must have migrated from elm, were collected with their offspring in June 1935, in Ferghana on shoots of pear. On 6th July only apterous individuals were taken. The literature on the biology of this Aphid is very briefly discussed [*cf. R.A.E.*, A **22** 342].

[Telenga (N. A.) & Bogunova (M. V.).] **Теленга (Н. А.) и Богунова (М. В.). The More Important Predators of Scale Insects and Aphids of Ussurian Part of Far East Region and the Ways of their Use.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 10 pp. 75–87, 4 graphs, 13 refs. Leningrad, 1936.

This is a detailed account of investigations that have already been noticed from a summary [*R.A.E.*, A **25** 149]. Descriptions are given of all stages of the three Coccinellids concerned, *viz. Chilocorus renipustulatus* subsp. *inornatus*, Weise, which is the one that attacks *Lepidosaphes yanagicola*, Kuw., *C. rubidus*, Hope, which attacks *Lecanium corni*, Bch., and *Coccinella* (*Harmonia*) *axiridis*, Pall., which attacks Aphids.

[Varshalovich (A.).] **Варшалович (А.). Study on some Seed-eating Chalcididae of the Genus** *Systole.* [*In Russian.*]—*Plant Prot.* 1936 fasc. 10 pp. 88–94, 6 figs., 5 refs. Leningrad, 1936. (With a Summary in English.)

The examination of samples of seeds of coriander (*Coriandrum sativum*) from various parts of southern Russia in 1929–33 showed that the Eurytomid, *Systole coriandri*, Nik. [*cf. R.A.E.*, A **22** 263], which had previously been recorded only from North Caucasus and Uzbekistan, also occurs in the Crimea, Voronezh, southern Ukraine and Kharkov. Its importance as a pest has apparently been overrated, though sometimes even 55 per cent. of the fruits were infested. The larva usually injured only one of the two seeds of the fruit and only destroyed the albumen, leaving intact the pericarp and the oil vessels. The infestation does not seem to affect the development of the fruit or the amount of oil yielded by it. Among material collected in Tashkent in 1929, a large number of parasites of the genera *Eupelmus* and *Tetrastichus* occurred together with dead individuals of *S. coriandri*.

Larvae of another species of *Systole* were found attacking seeds of anise (*Pimpinella anisum*) from the Crimea, Voronezh and Uzbekistan, *Ammi copticum* from the Crimea and Uzbekistan, and fennel (*Foeniculum vulgare*) from the Crimea. The injury caused to the seeds was not severe.

[Vereshchagin (V. A.).] **Верещагин (В. А.). Insect Pests of Cereal Crops of Far East Region.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 10 pp. 111–124, 18 refs. Leningrad, 1936.

Notes are given on 61 species of insects observed, chiefly in 1929–33, on cultivated cereals in the Ussuri Province and the region of the middle Amur in the Russian Far East. The only species that caused serious damage were: *Gryllotalpa africana*, P. de B., which does not occur in any part of the Russian Union except the Far East, and infests heavy moist soils; the wireworm, *Corymbites* (*Selatosomus*) *latus*, F., which becomes active as soon as summer rains set in and is therefore chiefly injurious to crops that are sown late; *Lachnosterna* (*Holotrichia*) *diomphalia*, Bates, and *L.* (*H.*) *sichotana*, Brenske, which completed their development in the Ussuri Province in two years and in the Amur region in one; the grasshopper, *Pararcyptera* (*Arcyptera*) *microptera sibirica*, Uv., which was especially abundant in the Amur valley; *Cirphis unipuncta*, Haw., and *Pyrausta nubilalis*, Hb., which were very common, the latter attacking practically all cultivated crops, and especially maize; the flea-beetles, *Chaetocnema hortensis*, Geoffr., and *C. aridula*, Gyll., which were favoured by a succession of rainy years, the abundance of weeds and the practice of sowing wheat late; *Meromyza saltatrix*, L., which often damaged 28–30 per cent. of the wheat plants in the Amur region, the main stems being chiefly attacked; and *Oscinella* (*Oscinosoma*) *frit*, L., which was widely distributed and infested barley, late-sown wheat and spring-sown rye in the Amur region, but caused practically no injury to oats.

A list of the pests observed is appended, showing the crops attacked and the severity of infestation.

Extracts from the Reports of the Section of Tobacco Protection of the A. I. Mikoyan Crimean Branch of the All-Union Institute of Tobacco and Makhorka Industry for the Years 1930-1935. I. Entomology. [*In Russian.*]—*Plant Prot.* 1936 fasc. 10 pp. 125–140. Leningrad, 1936.

Abstracts are given of a series of papers by various authors dealing with insects injurious to tobacco in the Crimea and their control.

Yu. Yu. Skalov, O. A. Kuz'mina, B. A. Keleberdinskiĭ & A. G. Skalova discuss a number of the more important pests and state that the most injurious were five species of grasshoppers [*R.A.E.*, A **23** 581], *Thrips tabaci*, Lind., the cutworms, *Euxoa segetum*, Schiff., *E. obelisca*, Schiff., *E. tritici*, L., and *E.* (*Feltia*) *obesa*, Boisd., and the Aphid, *Myzus* (*Myzodes*) *persicae*, Sulz.

Skalov, Skalova and Keleberdinskiĭ report that "Insectitzin," a new contact poison made of tobacco tar, which is a by-product obtained in the preparation of nicotine, proved to be the most effective of the sprays tested for the control of *Thrips tabaci*. Used at concentrations of 0·5 or 0·25 per cent. with the addition of 0·5 per cent. soft soap, it was considerably more toxic than anabasine sulphate applied at the same, or even higher, concentrations, and caused no injury to the tobacco plants. In a 0·2 per cent. concentration with 0·3 per cent. soft soap, anabasine was more effective than anabasine sulphate. Experiments carried out by Skalov and Keleberdinskiĭ showed that insecticides against the thrips are most effective in control if applied at the beginning of the vegetative period when the thrips is least numerous. The best method is to make three applications, 20, 27 and 37 days, respectively, after the planting of the tobacco. In investigations by Skalov on the effect of irrigation of tobacco plantations on the abundance of the thrips, the maximum reduction of its numbers and of the injury it caused was obtained by watering the plants from above (in imitation of rain) every 20–30 days at the rate of 7½ gals. of water per 1 sq. yard. A study carried out by Skalova, Keleberdinskiĭ, Skalov and E. S. Eremeeva in 1932 showed that different varieties of tobacco vary in susceptibility to injury by the thrips, though none is immune. The characters of the parents with the minimum and maximum coefficient of injury within the limits of one variety are not inherited by the progeny. A cross between a slightly injured and a susceptible variety produces a hybrid that is more resistant than the susceptible variety.

Experiments were carried out by Skalov, Keleberdinskiĭ and Skalova to find dusts and sprays that would be effective against various insect pests without scorching the tobacco. The tobacco tar, "Insectitzin," used with soap at the concentration employed against the thrips, was also very effective against *Myzus persicae*. Dusts of barium fluosilicate, mixed at rates of 10, 25 or 50 per cent. with a clay carrier, were very effective against cutworms, did not injure the tobacco and adhered well to the leaves. A spray of 2 lb. Paris green, 4 lb. lime and 100 gals. water was less effective against the cutworms than barium fluosilicate; it scorched the plants in places injured by the thrips, but the damage was severe only if the humidity was high.

Investigations by Skalov showed that spraying with anabasine sulphate is very effective against *Myzus persicae* on tobacco, a concentration of only 0·2 per cent. killing almost all the Aphids if both surfaces of the leaves were well covered by the spray. The addition

of 1 per cent. soft soap increased its effectiveness. The treatment did not injure the plants or affect the chemical composition or flavour of the tobacco from them.

Of the poisoned baits tested by Skalov, Keleberdinskiĭ and Skalova against the larvae of *Euxoa obesa* and *E. segetum*, those made of bran were the most attractive. Sufficiently high mortality was obtained from baits moistened with Paris green or sodium arsenite, both used at the rate of 4 lb. to 10 gals. water, or with sodium fluoride at the rate of 8 lb. Increasing the proportion of poison rendered the baits repellent. The baits were not always effective in the field even before the tobacco was planted out; they are most likely to be of value in protecting a field from migrating larvae. Experiments were therefore carried out by Keleberdinskiĭ, Skalova, A. M. Telushkin and Skalov with dusts and sprays applied to tobacco plants when infestation by the cutworms was beginning. All the larvae were killed, both in the laboratory and in the field, by dusting with 10 per cent. barium fluosilicate mixed with a clay carrier. Dusting with 10 per cent. sodium fluosilicate and clay killed 80 per cent. of the larvae in the laboratory; and barium fluoride, without a carrier, killed 90 per cent. As a spray, 2 per cent. barium fluosilicate was more effective than 0·2 per cent. Paris green.

The control of *Ephestia elutella*, Hb., in stored tobacco was studied by Skalov and V. V. Sheffer, who state that fumigation with chloropicrin at the rate of 3 oz. to 1,000 cu. ft. space for 24 hours is very effective against the larvae, irrespective of their position in the bales of tobacco, provided that the room is completely air-tight. At this rate of application, the gas does not affect the tobacco in any way. Since the buildings in which tobacco is stored in the Crimea are not air-tight, 6 oz. chloropicrin should be used per 1,000 cu. ft. for 48 hours.

Laboratory experiments in fumigation with chloropicrin against *Ptinus latro*, F., which causes considerable damage to stored seeds of tobacco in the Crimea, were carried out by Keleberdinskiĭ and G. I. Grabovskiĭ. At 20°C. [68°F.], a 7–8 per cent. moisture content of the seed and an exposure of 24 hours, chloropicrin at the rate of 1, 1½, or 2 oz. to 1,000 cu. ft. space was highly toxic to all stages of the beetle and penetrated well into the stored seed. The treatment only slightly affected the germination of the seeds.

[Nikol'skiĭ (V. L.).] **Никольский (В. Л.). On the Scale Insects of economic Importance for Parks and Forests.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 10 pp. 153–156, 6 refs. Leningrad, 1936.

Notes are given on the economic importance, food-plants and distribution in the Russian Union (chiefly the Caucasus and the Crimea) of 13 species of Coccids that attack trees in forests and parks. Of these the most important are *Lecanium rufulum*, Ckll. (*pulchrum*, King) and *Asterolecanium variolosum*, Ratz., both of which severely infest oaks in North Caucasus and Georgia; *L. corni*, Bch., which attacks a large variety of trees and is very harmful to hazel (*Corylus*) and *Euonymus* in the Caucasus; *Chionaspis euonymi*, Comst., which infests and often kills *Euonymus* (which is now being cultivated in the Russian Union as a source of rubber); *C. salicis*, L., which is specially injurious to young limes [*Tilia*] in nurseries in Leningrad; *Eriococcus buxi*, Boy., which is a common pest of box [*Buxus*] in the Caucasus;

Lepidosaphes ulmi, L., which attacks elm, poplar and fruit-trees ; and *Leucodiaspis* (*Leucaspis*) *pusilla*, Lw., which is a serious pest of pines in the Crimea [*cf. R.A.E.*, A **17** 262].

[Titov (K.).] **Титов (К.). The Insect Pests of** *Papaver somniferum*. [*In Russian.*]—*Plant Prot.* 1936 fasc. 10 pp. 156–158. Leningrad, 1936.

Poppy (*Papaver somniferum*) is intensively cultivated in many parts of the Russian Union, and particularly in two areas in Central Asia. On the basis of observations carried out in 1929–31 in these two areas and records from the literature, a list is given of 47 species of insects and 2 mites that attack it, with brief notes on the types of damage caused.

[Grankina (K.).] **Гранкина (К.). The Testing of Natrium Silicofluorid against** *Psylliodes attenuata* **Koch.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 10 pp. 158–159. Leningrad, 1936.

In small-scale field experiments carried out in the second half of May 1935 in the Kuĭbuishev Province, a dust of equal parts of sodium fluosilicate and ash was applied at the rate of 18 lb. per acre to sprouting hemp heavily infested by *Psylliodes attenuata*, Koch. The treatment temporarily reduced the numbers of flea-beetles by 80 per cent., and though they began to increase again after 8 days, the plants had grown stronger in the interval and produced up to two pairs of leaves, so that they were not killed. In no case did the dust scorch the plants.

[Troshanin (P. G.).] **Трошанин (П. Г.).** *Stenolechia gemmella* **L. and its economical Significance.** [*In Russian.*]—*Plant Prot.* 1936 fasc. 10 pp. 160–163, 3 refs. Leningrad, 1936.

A serious infestation of oak forests by *Stenolechia gemmella*, L., occurred in the environs of Kazan in the summer of 1928, when about 70 per cent. of the shoots examined were infested. Laboratory and field observations in 1928–30 showed that it has apparently only one generation a year. The place of oviposition has not been ascertained, but both larvae and pupae occur in the young shoots of the oaks. The larvae are present in June and early July, and the first pupae at the end of June. The adults emerge in August and sometimes also in early September. The infested shoots wither and die, and the yield of acorns is decreased. In 1928, many of the larvae were destroyed by a Hymenopterous parasite, which was also active in 1929. The moths were again observed in the oak forests in 1934 and 1935, and this indicates that another outbreak may occur under favourable conditions.

Other pests found on oaks near Kazan included *Curculio* (*Balaninus*) *glandium*, Marsh., and *Cydia* (*Carpocapsa*) *splendana*, Hb., which infested the acorns, and *Lymantria* (*Porthetria*) *dispar*, L., and *Tortrix viridana*, L.

Sieke (F.). **Ein Abhörapparat zur Feststellung von Hausbockbefall.** [A Sound Amplifier for ascertaining Infestation by *Hylotrupes bajulus*.]—*Zbl. Bauverw.* **56** no. 15 p. 337, 1 fig. Berlin, 8th April 1936. [Recd. May 1937.]

Infestation of timber by *Hylotrupes bajulus*, L., is revealed by the frass, the exit-holes and the sound made by the larvae when boring.

The frass and the holes differ in appearance from those of other wood borers [*cf. R.A.E.*, A **24** 129, 476, 612], but it is only possible to know that injury is still in progress if living larvae or adults are discovered or if the sound of boring can be heard. Schwarz, Kranz and the author in Hamburg devised an apparatus that electrically amplifies this sound. It is received by a small microphone, and rendered audible in headphones by means of a three-valve amplifier housed in a small case and worked by a battery. Owing to the high amplification, the apparatus is very sensitive to electrical interference. Non-electrical environmental noises that were at first very troublesome were almost completely eliminated by modifying the receptor part of the apparatus. The microphone has since been replaced by an electrical pick-up screwed on to a gramophone needle stuck into the wood that is being examined. The larvae scrape off thin shavings with their mandibles, producing an almost rhythmic sound that can, after a little practice, be distinguished from other noises. The sound can also be reproduced by a loud-speaker for demonstration purposes. The apparatus has detected infestation in beams where no external injury was visible. It is particularly useful in the examination of treated timber to ascertain whether the insecticide used has killed the larvae, though some patience is needed as they do not feed continuously. It is often sufficient to warm the timber to cause them to start feeding.

Amtliche Pflanzenschutzbestimmungen. [Official Regulations on Plant Protection.]—*Beil. NachrBl. dtsch. PflSchDienst* **9** no. 3 pp. 62–80. Berlin, 1st April 1937.

This part includes the text of an Act dated 5th March 1937 to co-ordinate regulations for the protection of cultivated plants in Germany. It empowers the Minister for Food and Agriculture to issue against native and importable diseases and pests all necessary regulations relating to the protection of plants, plant products and parts of plants. The Minister is the sole authority and the Biologische Reichsanstalt for Agriculture and Forestry is entrusted with the research and other technical work underlying the regulations.

Schwartz (M.). **Das Reichspflanzenschutzgesetz.** [The Reich Plant Protection Law.]—*NachrBl. dtsch. PflSchDienst* **17** no. 4 pp. 29–32. Berlin, April 1937.

This is a survey of the development of German legislation for plant protection from 1870 to the new Act of 1937 [see preceding abstract].

The Importation of Plants (Amendment) Order of 1937.—*S. R. O.* 1937 no. 197, 2 pp. London, 10th March 1937.

This Order to prevent the introduction of the chrysanthemum midge (*Diarthronomyia hypogaea*, Lw. [*cf. R.A.E.*, A **25** 389]), which came into operation on 12th April 1937, prohibits the importation into England and Wales of chrysanthemum plants from any country outside the British Isles, except under licence. Except in the case of consignments consisting wholly of potatoes, a statement must be forwarded with each consignment of living plants and parts thereof that it does not contain any chrysanthemum plant.

Massee (A. M.). **The Pests of Fruits and Hops.**—Demy 8vo, 294 pp., 27 pls., many refs. London, Crosby Lockwood & Son Ltd., 1937. Price 15*s*.

This practical text-book deals with the more important pests of orchard and nut trees, bush fruits, strawberries and hops in Great Britain. It is divided into sections, each dealing with a separate crop, and including brief notes on means of identification, bionomics and methods of control of each pest of that crop, with cross references where more than one is attacked by the same insect and a bibliography of the systematic and economic literature on the pest concerned. Numerous illustrations are included to enable growers to identify the most injurious insects, either from their appearance or from the nature of the damage done.

In additional sections, beneficial and harmless insects occurring in the orchards are discussed, and more detailed information is given on the preparation, application and effect of insecticides. A final chapter on types of spraying equipment and their use is contributed by J. Turnbull.

Salt (G.). **The Sense used by *Trichogramma* to distinguish between parasitised and unparasitised Hosts.**—*Proc. roy. Soc.* (B) **122** no. 826 pp. 57–75, 10 refs. London, 3rd March 1937.

In this paper, which is the fifth of a series [*cf. R.A.E.*, A **25** 50], an account is given of experiments to determine the sense used by *Trichogramma evanescens*, Westw., to distinguish between parasitised and unparasitised hosts (eggs of *Sitotroga cerealella*, Ol.). The following is the author's summary: It has already been shown [**22** 204] that ovipositing females of *T. evanescens* are able to distinguish healthy hosts from those already parasitised. The present study deals with the sense used in the discrimination. Sight, hearing and touch are eliminated, and the chemical sense is indicated as the one used. The parasite is able to distinguish between clean hosts and hosts that have been merely walked upon, not stung or oviposited in, by another female of its species. If hosts that have been walked on are washed in water, the parasite can no longer distinguish them. The means of discrimination is of a chemical nature and, being volatile, can be considered an odour. If hosts that have been actually parasitised are washed, the parasite is unable to distinguish them externally from healthy hosts and attacks them. As soon as its ovipositor has penetrated into them, however, the parasite becomes aware that they are parasitised and usually withdraws immediately without laying an egg in them.

Two different faculties, then, can perform the discrimination. One recognises an external odour and inhibits attack; the other distinguishes an internal difference and inhibits oviposition. The external odour passes off in time, but the internal means of discrimination is lasting. The chemical trace left on the surface of the host is not the general body odour of the parasite, but a more specific smell probably produced by glands on the tarsi. It is left not only on hosts but also on the substratum on which the parasite walks. Owing to its method of discrimination, the parasite sometimes mistakes healthy for parasitised hosts. These therefore escape parasitisation and are

important in the population problem. The paper affords a further demonstration [*cf.* **23** 390] that *Trichogramma* selects its hosts by a series of criteria which are not necessarily criteria of suitability.

THURSTON (H. W.) & WORTHLEY (H. N.). **Some Problems in Apple Spraying in Pennsylvania.**—*Bull. Pa agric. Exp. Sta.* no. 324, 19 pp., 3 figs., 14 refs. State College, Pa, March 1936. [Recd. 1937.]

Sections of this bulletin deal with dormant sprays against *Anuraphis roseus*, Baker, and *Paratetranychus pilosus*, C. & F., and lead arsenate and other sprays against the codling moth [*Cydia pomonella*, L.] on apple in Pennsylvania, much of the information being based on the literature. The results of recent experiments suggest that lead arsenate should still be relied upon in first-brood sprays in which an effective stomach poison is most needed. The inclusion of a form of fixed nicotine that requires no oil spray merits study, for its use should reduce the number of stings and its action as a stomach poison, though not so marked as that of lead arsenate, may perhaps permit the latter to be dispensed with earlier in the season than is at present possible. Fruit washing cannot be avoided while lead arsenate is used in applications later than the first cover spray.

DITMAN (L. P.) & CORY (E. N.). **The Corn Earworm.**—*Bull. Md agric. Exp. Sta.* no. 399 pp. 77–90, 3 figs., 5 refs. College Park, Md, July 1936. [Recd. 1937.]

The results are given of three years' work in continuation of previous investigations on the corn ear-worm [*Heliothis armigera*, Hb. (*obsoleta*, F.)] on maize in Maryland [*cf. R.A.E.*, A **22** 318]. In general, infestation has decreased gradually throughout the State in the last three years. In tests of varietal resistance of sweet maize in 1934, two varieties were much less injured by the larvae than others. A late field of one of them, however, was badly damaged by *Laphygma frugiperda*, S. & A., in 1935.

Experiments on poison baits for the moths are described in detail. Preliminary tests [**21** 238] showed that the three most attractive sugars were sucrose, invert sugar and fructose, given in order of attractiveness on the basis of molar concentration. On a per cent. solution basis, the relation between the sugars was the same, apparently twice as much invert sugar as sucrose in solution being required to produce a 50 per cent. response in the moths and about 10 times as much fructose. In tests with poisons, pyrethrum in alcoholic solution diluted with water, and sodium lauryl sulphate appeared to be distasteful. Good results were obtained with a 1 per cent. solution of sodium arsenite, but a 0·3 per cent. solution was not lethal. The maximum concentration of poison on which the moths would feed was slightly in excess of 4 per cent. for sodium arsenite, and 4 per cent. for the others tested. The minimum survival time after feeding on 4 per cent. solutions was 10 hours for antimony potassium tartrate [tartar emetic], 3–5 hours for thallium sulphate and for sodium fluoride, and less than 1 hour for sodium arsenite. As moths must be killed quickly in order to stop oviposition, sodium arsenite was used for field experiments with baits in 1935. The feeder traps consisted of a narrow trough for the non-fermenting poison bait, fitted into a wider

container, which was sometimes used for a supplementary fermenting bait. A broad wick of bleached muslin was hung above, so that its lower end was in the poison bait. This consisted of ¾ lb. sodium arsenite, 6 lb. sucrose and 2 U.S. gals. water, and its attractiveness did not appear to be increased by the addition of the fermenting bait (1 U.S. quart malt syrup, 4 U.S. gals. water, ½ U.S. gal. molasses and 6 lb. sucrose). The percentage of infestation in the field in which these traps were used was only little over half that in some neighbouring fields. It was impossible to determine that the reduction in infestation was due to the poison, but, in a test later in the season, the moths were observed feeding at the traps and dead on the ground below them.

In experiments to determine the value of sucrose and gelatine as adhesives for a lead arsenate spray, the sucrose gave inconsistent results and the gelatine was of no value. Ten applications of dusts were made in August and early September and the results ascertained on 12th September. The percentages of ears infested were 95·3 in the control plots, 21·5, 32·1 and 91·5, respectively, in those treated with barium fluosilicate (Dutox), lead arsenate, and a fixed nicotine [and bentonite] preparation, 155 A, and 93·1 with the same preparation of nicotine in a gelatine spray.

Ditman (L. P.), Cory (E. N.) & Buddington (A. R.). **The Vinegar Gnats or Pomace Flies—their Relation to the Canning of Tomatoes.** —*Bull. Md agric. Exp. Sta.* no. 400 pp. 91–111, 7 figs., 5 refs. College Park, Md, July 1936. [Recd. 1937.]

The rapid multiplication of flies of the genus *Drosophila*, of which the most common are *D. melanogaster*, Mg., and *D. repleta*, Woll., sometimes makes them serious pests of tomatos grown for canning in Maryland, infestation occurring both in the field and in the canneries. They breed in fermenting fruit, vegetables or manure, but, when numerous, oviposit in cracks in the fresh tomatos as well as in fermenting fruit. The life-cycle of *D. melanogaster* is completed in 8 days or slightly less at 85°F., and in 11–13 days at 75°F. Females laid 430 eggs at an average rate of 14·84 per day at 77–86°F., and 941 eggs at the rate of 26 per day at 67–77°F. The average length of adult life at 65°F. was 70·6 days for females and 43·4 for males; the duration of life decreased as the temperature was increased. *D. repleta*, all stages of which are briefly described, is found round kitchens and about decaying and fermenting vegetables. At 75° and 85°F., the life-cycle is completed in 11–13 and 10–11 days, respectively. Females may oviposit within 3–4 days of emergence.

Observations in the field showed that infestation increases towards the end of the packing season for tomatos, largely because the rotten fruit accumulates in the field, and the cooler temperatures are more favourable to the flies. Experiments were carried out during 1935 on 3 plots of tomatos, two of which were well cultivated and kept free from weeds and rotten tomatos, the ripe fruit being picked daily, while on the third much rotten fruit was present. Oviposition in cut tomatos laid as traps showed that infestation was very much greater on the third plot. Dusting with pyrethrum did not appear to reduce the numbers of adults in the field, nor did trapping in jars with a bait of fermenting fruit either in the field or the cannery. A pyrethrum spray greatly reduced the numbers of flies at the washing shed of a cannery, but was less effective where the raw tomatos were stored, as

it was difficult to reach the flies deep in the baskets of fruit. Measures that led to a decrease in infestation at different stages during the process of canning were : the use of tomatos on the day they were picked ; the selection of tomatos that are in good condition ; the thorough culling of rotten fruit at least twice during the processes, once before and once after washing ; thorough washing, preferably with a spray washer ; and careful peeling.

BRAUER (A.). **Susceptibility of Bruchid (Coleoptera) Eggs to KCN (Abstract).**—*Anat. Rec.* **67** Suppl. no. 1 p. 89. Philadelphia, Pa, 25th December 1936.

The following is the abstract. Eggs of *Bruchus quadrimaculatus*, F., incubated at 28°C., are most susceptible to KCN (1/100 mol.) during the first 6½ hours incubation. During this interval susceptibility drops slightly. Development is completely arrested in 85 per cent. of the cases after 25 minutes treatment. From 7½ to 12 hours incubation the eggs are highly resistant as regards complete arrest. One and a quarter hours treatment is required to halt development in 90 per cent. of the eggs. After shorter treatment, these eggs are highly anomalous in antero-posterior axial development of embryo. The period from 15 to 18 hours incubation is one of higher susceptibility than the former period. Sixty minutes treatment completely arrests development of over 80 per cent. of the eggs. Bifida of the ventral plate is the principal anomaly resulting from sub-lethal dosage. After this period eggs are highly resistant to treatment, though anomalies of mouth-parts result after treatment at 24 hours incubation. Each of the enumerated periods corresponds to a phase of development as follows : the first period to blastokinesis and to embryonic determination ; the second to blastoderm formation and to first axial development ; the third to middle germ layer formation and to ventral nerve cord development ; the fourth to growth of mouth parts.

STRONG (L. A.). **Report of the Chief of the Bureau of Entomology and Plant Quarantine, 1936.**—121 pp. Washington, D.C., U.S. Dep. Agric., 1936.

A concise account is given of work on insect pests carried out in the United States during the year ending 30th June 1936, some of which has already been noticed.

Experiments on the exact amount of beta-naphthol and oil required on chemical bands for full effectiveness against larvae of the codling moth [*Cydia pomonella*, L.] on apple showed that 0·32 oz. of standard mixture per ft. of band (2 ins. wide) was necessary in the north-west, and 0·5 oz. in the centre and east ; in the eastern district the addition of small quantities of aluminium stearate reduced the amount of the mixture required on the band by about 20 per cent. Among the baits effective against moths in the field were one containing 1 cc. pine-tar oil in 1 U.S. quart 10 per cent. molasses and another with ½ cc. bromostyrol in 1 U.S. quart 10 per cent. brown sugar solution ; oils of sassafras or mace were effective instead of bromostyrol. In tests against the hibernating larvae, a 20 per cent. emulsion of pine oil alone killed 38 per cent., whereas the addition of 1 per cent. alpha-naphthylamine and nicotine increased the kill to 75 and 100 per cent.,

respectively ; a number of other substances did not increase the mortality. Satisfactory control of the grape berry moth [*Polychrosis viteana*, Clem.] was given by thiodiphenylamine (phenothiazine) ; some injury to the leaves was produced by its use in conjunction with fish oil, and the russeting of some of the clusters of grapes may also have been partly due to this cause. Nicotine sulphate with summer oil emulsion or with fish oil gave 75–85 per cent. control of the pecan nut case bearer [*Acrobasis caryae*, Grote] in Georgia when applied in late spring, and nicotine with Bordeaux mixture gave nearly as satisfactory results. In Texas, nicotine sulphate with oil gave even better control. Bordeaux mixture ($1\frac{1}{2} : 50$) with calcium arsenate prevented injury to the foliage by the latter, but even such low concentrations of Bordeaux mixture led to an increase in infestation by the black pecan aphis [*Melanocallis caryaefoliae*, Davis]. Little control of the hickory shuckworm [*Enarmonia caryana*, Fitch] on pecan was obtained by ploughing the shucks in during the winter, but the same measure was effective in the spring when the larvae in them had pupated. The liberation of *Trichogramma minutum*, Riley, against pests of pecan has been discontinued, as the recoveries were unsatisfactory.

Infestation of drying pears by *Ephestia figulilella*, Gregson, and the dried-fruit moth [*Plodia interpunctella*, Hb.] was reduced by more than 90 per cent. by the use of tobacco shade cloth when the fruits were drying in trays in the field. A motor-driven shaker screen for sifting raisins reduced infestation by 78 per cent. More than a million larvae of *E. figulilella* were present in a ton of mulberries in the period when the latter were the only widely distributed food available, and it was shown that 94 per cent. of the spring-generation adults emerged during this period. Fumigation of packed raisins with methyl bromide or a mixture of 3 parts ethylene dichloride and 1 part ethylene oxide, at the rates of 4 and 7 cc., respectively, per 25 lb. box gave complete control of *E. figulilella* and the Indian meal moth [*P. interpunctella*]. Dispersal studies showed that the dried-fruit beetle [*Carpophilus hemipterus*, L.] may migrate more than 2 miles in 4 days.

Sulphur dusts containing zinc compounds (used for the control of mottle-leaf) in proportions of 4·5–11 per cent. on a basis of metallic zinc, gave as good control of the orange thrips [*Scirtothrips citri*, Moult.] in California as sulphur dust alone. In Porto Rico, *Strategus quadrifoveatus*, P. de B., kills about 75 per cent. of the young replanted coconut palms within 5 years, but they can be protected from it by enclosing the nut and the lower 5 ins. of the sprout in $\frac{1}{2}$ in. square mesh galvanised iron wire netting.

The hard winter without snow in 1935–36 caused mortalities of 50 per cent. or more among the larvae of the Japanese beetle [*Popillia japonica*, Newm.] in southern New Jersey. Laboratory tests did not indicate a satisfactory substitute for lead arsenate as a stomach poison for the larvae. As a top dressing, lead arsenate was equally effective in protecting turf whether applied as a spray or mixed with sand, tankage, or activated sludge, but when used with a complete fertiliser or green-sand marl its effectiveness was decreased. The germination of conifer seeds was not prevented by mixing lead arsenate with the soil of the seedbeds, but the growth of the seedlings was usually affected. The total number of colonies of imported parasites released against *P. japonica* had reached over 1,100 by the end of 1935 ;

110 out of 195 colonies examined during the year were definitely established.

Sweetened sprays containing tartar emetic were more effective than any other tested in Mexico against fruit-flies of the genus *Anastrepha*. Laboratory studies showed that *A. serpentina*, Wied., which can survive freezing temperatures [*cf. R.A.E.*, A **24** 292], lives for some months and reproduces as abundantly as *A. ludens*, Lw. Records are given of the numbers of adults of these two species and 7 other Trypetids trapped in Texas. Very few larvae of *A. ludens* were found, and none was obtained from wild fruits examined. In the Panama Canal Zone, *A. serpentina*, which usually attacks sapotes [*Lucuma*], was reared from oranges, which it had apparently infested naturally. The two West Indian species of *Anastrepha* known to occur on Key West [**24** 417] were taken in traps in several localities on the mainland of southern Florida early in 1935. No larvae were discovered. It appears likely that two other related fruit-flies, probably undescribed, which were also taken on the mainland, do not attack fleshy fruits of commercial value. All date-growing districts in the United States now appear to be free from date scale, *Parlatoria* [*blanchardi*, Targ.].

The Black Hills beetle [*Dendroctonus ponderosae*, Hopk.] caused considerable damage to pines in the central region of the Rocky Mountains. The salvage logging of timber killed by the western pine beetle [*D. brevicomis*, Lec.] was tried during 1935, and, by moving only infested and lately killed trees, was profitable where the volume taken out was not less than 400 board feet per acre. Extreme cold is important in the natural control of bark-beetles [*cf.* **21** 648], but the temperature lethal to a particular species varies with the climatic conditions of the region from which the individuals come. Thus individuals of the mountain pine beetle [*D. monticolae*, Hopk.] from the south Sierra region and the northern Rocky Mountains require temperatures of 2·5° and —17°F., respectively, for complete mortality. The European spruce sawfly [*Diprion polytomus*, Htg.] is generally distributed throughout New England and as far as central New York, but the infestation is not heavy. Infestation by the satin moth [*Stilpnotia salicis*, L.] is increasing in a number of localities in the infested area. At the end of 1936, 4,307 square miles in the east of the United States were infected with Dutch elm disease; this includes an increase during the year of 1,829 sq. miles, in which some of the infestations were several years old. A method of treating elm stumps that eliminated barking and painting with creosote consists in pouring copper sulphate powder into pockets made by separating the bark from the wood. Sprouting is prevented and also, apparently, the attack of bark-beetles.

Infestation of maize by the European corn-borer [*Pyrausta nubilalis*, Hb.] increased generally in 1935. Over 160,000 parasites of Oriental and European origin were liberated against it during that year in 60 fresh areas. Sprays that give a high degree of protection against infestation included nicotine tannate, ground derris, a highly dispersed nicotine bentonite and thiodiphenylamine; a "dual fixed nicotine" consisting of nicotine tannate and nicotine bentonite was effective as a dust. Experiments on the hibernation of the corn earworm [*Heliothis armigera*, Hb.] in the central and eastern States indicated that it did not survive the winters in significant numbers north of latitude 39°. Barium fluosilicate may be used for the protection of valuable maize against the south-western corn borer [*Diatraea grandiosella*, Dyar].

Euxesta stigmatias, Lw., infested 28–92 per cent. of the ears of maize in Porto Rico, but its numbers were reduced by the mechanical measures used against *H. armigera*. Studies on the control of the chinch bug [*Blissus leucopterus*, Say] have shown that the elimination from an area of all small grains except oats (the least attractive) might materially reduce the damage, but would not prevent it, as some infestations develop directly on maize. No single small grain was effective as a trap crop, as the difference in attractiveness was not sufficiently great. The sugar-cane borer [*Diatraea saccharalis*, F.] caused a loss of about £280,000 in Louisiana during 1935, although infestation was less than normal. Liberation of *Trichogramma minutum* against it has been discontinued, as it was ineffective. A large proportion of the injury to rice kernels known as "pecky rice," which in 1935 resulted in an estimated loss to the growers of £80,000–£100,000, has been proved to be due to the rice stink bug, *Solubea* (*Oebalus*) *pugnax*, F. Aphids found able to transmit sugar-cane mosaic in Porto Rico, in addition to *Aphis maidis*, Fitch, were *Carolinaia* (*Hysteroneura*) *setariae*, Thos. [*cf.* **24** 775], *C. cyperi*, Ainslie, which has not yet been shown to be important in the field, and, apparently, *A. nerii*, Kalt.

Early cutting of lucerne is fairly successful in controlling the alfalfa weevil [*Hypera variabilis*, Hbst.] in Utah and Oregon. Further infestations of the weevil have been discovered in Colorado, Oregon, South Dakota and Nebraska. Varieties of vetch were found to differ in susceptibility to *Bruchus brachialis*, Fhs. More than 70 per cent. of the flowers of the lucerne seed crop in Arizona may be injured as a result of the presence of large numbers of Lygaeid bugs. A relation appeared to exist between the abundance of certain weeds and of the bugs, and a heavy mortality of the latter may be secured by timing the cutting of the hay crop with reference to the adjacent seed crops. Damage to lucerne seed by Pentatomids ranges from 1 to 44 per cent.

A mixture of methyl formate with carbon dioxide gave unsatisfactory results in the fumigation of flour mills when piped directly into the machinery [*cf.* **25** 376], probably owing to its slow action. Chloropicrin gave complete mortality of adults of the rice weevil [*Calandra oryzae*, L.] in storage bins, but a mixture of ethylene oxide and carbon dioxide applied to the top of the bin and at 4 levels when it was being filled was unsatisfactory. It appears that the amount of gas required for fumigation of rice and possibly other products depends on the quantity fumigated rather than the space it is stored in. Recirculation of the fumigant in the vacuum chamber reduces the dosage required by 25 per cent., and a more uniform distribution is obtained with several points of entry for the gas instead of only one, near which selective absorption takes place. Bags of flour can be sterilised in 24 hours at temperatures of 170–185°F., and forced air-circulation helps to raise the temperature in the interstices between the bags.

In experiments on the control of wireworms in the north-west, 800 lb. crude naphthalene per acre were ploughed into the soil, and where the prevalent soil-temperature reached 70°F. or more, about 95–99 per cent. of the wireworms were killed. Better results were obtained in loam or sandy loam soils than in silt loam soils. In the State of Washington, of potatoes planted in a field following lucerne that had been dried out (by withholding the irrigation water) during 1934, 4 per cent. were injured by wireworms, while potatoes in an

adjoining field, which had not been dried out before planting, were very severely damaged [*cf.* **25** 249]. The application of dilute solutions of dichlorethyl ether into the soil under trap rows of beans also gave promising results.

Promising control of the pea Bruchid [*Bruchus pisorum*, L.] was obtained by border crops ploughed under before the main crops blossomed. In Idaho, this Bruchid cannot survive temperatures below −20°F. Preliminary experiments in California show that the lima bean pod borer [*Etiella zinckenella*, Treit.] can be controlled with cryolite. Contact insecticides, including nicotine sulphate and light oil, caused appreciable mortality of the leaf-mining larvae of the tomato pinworm [*Phthorimaea lycopersicella*, Busck], which is a serious pest of tomatos in southern California. A survey of mole crickets in the east and south-east showed that *Scapteriscus acletus*, Rehn & Hebard, was the predominant species. Turnips treated with rotenone diluted with sulphur or talc against turnip aphids [*Rhopalosiphum pseudobrassicae*, Davis] were more suitable for market than those treated with nicotine. In Arizona, dusts containing cryolite, applied to lettuce three days after the plants were thinned, gave good control of *Autographa* spp., but none of the insecticides tested was effective against the beet armyworm [*Laphygma exigua*, Hb.] on lettuce. Sprays containing nicotine sulphate or rotenone in combination with wetting agents, and dusts containing naphthalene with hydrated lime or lime-free sulphur with manganese dioxide all gave promising results against the onion thrips [*Thrips tabaci*, Lind.] in Porto Rico. On cabbage, dusts containing derris were more effective than pyrethrum, cryolite or calcium arsenate against the imported cabbage worm [*Pieris rapae*, L.], while of derris, cryolite, Paris green, pyrethrum and calcium arsenate, the most effective against the cabbage looper [*Plusia brassicae*, Riley] were derris and cryolite, and against the diamond-back moth [*Plutella maculipennis*, Curt.], derris and calcium arsenate. Laboratory tests showed that the ground root of *Tephrosia* (*Cracca*) *virginiana* was as effective against the common caterpillar pests of cabbage as derris or cubé [*Lonchocarpus*] containing equal percentages of active ingredients. Atomised sprays of pyrethrum extract in oil gave 95 per cent. mortality of the leafhopper [*Eutettix tenellus*, Bak.] on beet.

A dust of calcium arsenate and sulphur gave the best control of the strawberry weevil [*Anthonomus signatus*, Say] in strawberry beds, but probably injured the plants, as dusts containing rotenone resulted in the production of a larger quantity of marketable fruit. Tests against the raspberry fruit-worm [*Byturus unicolor*, Say] showed that two sprays of lead arsenate applied before blooming, with one containing derris applied after blooming, gave satisfactory control and the fruit was free from arsenical residues. Control of *Eriophyes essigi*, Hassan, on blackberry was given by lime-sulphur sprays in the dormant period, followed by sprays containing wettable sulphur or emulsions of refined petroleum or coal-tar oil during the growth of the plant until the fruit began to ripen. The tobacco flea-beatle [*Epitrix parvula*, F.] was controlled by dusts of derris or cubé containing 1 per cent. rotenone, for which sterilised tobacco dust was the most effective diluent. A bait containing Paris green, maize meal and oil of mirbane [nitrobenzene] gave good control of light infestations of *Crambus caliginosellus*, Clem., on tobacco when applied soon after the plants were set in the field. Preliminary tests with dusts of pyrethrum

against the adults of the tobacco moth [*Ephestia elutella*, Hb.] in storage warehouses of the closed type gave promising results. Although sprays containing rotenone are not so effective against the gladiolus thrips [*Taeniothrips simplex*, Morison] as mixtures of Paris green and sugar, they do not injure the foliage. Sprays containing rotenone or organic thiocyanates, with suitable spreaders, gave some control of red spider [*Tetranychus telarius*, L.] and thrips on cucumbers and tomatos in greenhouses.

In cage tests of dusts against the cotton boll-weevil [*Anthonomus grandis*, Boh.], mixtures of calcium arsenate with Paris green at the rates of 3 : 1 and 9 : 1 were more effective than calcium arsenate alone ; but in field tests, calcium arsenate alone gave better results than these mixtures or than derris with sulphur (1 per cent. rotenone), thiodiphenylamine with sulphur (1 : 9), and calcium arsenate with lime (1 : 1). In a part of South Carolina where infestation was not severe, the three best dusts tested in order of profitable returns in control were : calcium arsenate with lime (1 : 2) employed after the infestation had reached 10 per cent. ; calcium arsenate with lime (1 : 1) ; and calcium arsenate alone. Lime mixtures reduce the danger of soil poisoning and heavy infestation by Aphids. Experiments and experience over several years indicate that the germination of the seed and survival of the seedlings of cotton, maize and soy beans are reduced in plots that have received heavy applications of calcium arsenate against the weevil. For the control of the cotton fleahopper [*Psallus seriatus*, Reut.], dusting with sulphur resulted in an average gain of 167·5 lb. of seed cotton per acre, and a mixture of Paris green and sulphur (1 : 9) resulted in an average gain of 220 lb. A mixture of calcium arsenate and sulphur (1 : 4) also gave better results than sulphur alone. Cage experiments during the last 3 years have shown that arsenicals are more effective than sulphur against the adults. *Anaphes anomocerus*, Gir., and a species of *Erythmelus* were found parasitising the eggs of *P. seriatus*. A serious outbreak of the cotton bollworm [*Heliothis armigera*, Hb.] occurred in north-eastern Texas in the summer of 1935 ; the most satisfactory control was given by calcium arsenate dust, applied at intervals of 4–5 days for as long as the bollworm larvae were present. In the autumn, most of the larvae died from disease. Recoveries have been made of *Microbracon kirkpatricki*, Wlksn., 122,000 of which were liberated in Texas, Mexico and Porto Rico against the pink bollworm [*Platyedra gossypiella*, Saund.]. *Chelonus blackburni*, Cam., was also released in Texas and Porto Rico. *M. mellitor*, Say, from Hawaii, was not reared in sufficient numbers for release, but a winter survival of 89 per cent. was recorded in hibernation tests. The area infested during 1933 was smaller than at any time since the 1926 crop. In Porto Rico, the seed-pods of the ornamental trees, *Montezuma speciosissima* and *Thespesia populnea*, commonly used for roadside planting, were found to be the most important alternative hosts of the pink bollworm. It was established that resting-stage larvae occur there. Colonies of *Pimpla* (*Exeristes*) *roborator*, F., as well as of *C. blackburni* and *M. kirkpatricki* were released in Porto Rico and some recoveries were made. At least 15 species of Rhynchota attack cotton in Arizona, including *Euschistus impictiventris*, Stål, *Chlorochroa sayi*, Stål, and *Thyanta custator*, F., on the bolls, and *Lygus hesperus*, Knight, and *P. seriatus* on the squares. Cotton is not the preferred food of any of these, and it is only attacked when others are not available. Of bolls

with which *C. sayi* and *E. impictiventris* were confined, 30 and 20 per cent., respectively, developed boll rot, while tests with *Dysdercus mimulus*, Hussey, have all given negative results. Experimental breeding of *Anthonomus grandis thurberiae*, Pierce, on cotton exclusively has shown that it is not likely to become a serious pest in Arizona.

Fumigation with hydrocyanic acid gas of warehouses where cotton-seed meal is stored in bulk or in sacks, gave good control of the cigarette beetle [*Lasioderma serricorne*, F.]. When heavy paper bags were used instead of fabric sacks, eggs were laid along the stitching and the larvae entered the meal, but the exit holes so destructive to fabric bags were not made. Infestations of the webbing clothes moth [*Tineola biselliella*, Humm.] and the black carpet beetle [*Attagenus piceus*, Ol.] in furs and clothing cannot arise when the garments are kept at 59°F. and 42 per cent. relative humidity.

Parasites imported into the United States during the year included ; *Tiphia sternata*, Parker, against the Asiatic garden beetle [*Aserica castanea*, Arrow] ; *Microgaster tibialis*, Nees, from France against *Pyrausta nubilalis* ; *Peridesmia phytonomi*, Gah., from France, and *Tetrastichus incertus*, Ratz., both against *Hypera variabilis* ; *Anachaetopsis nitidula*, Rond., from France, and *Tetrastichus* sp. (a different form from that introduced from Europe) from Japan, both against the elm leaf beetle [*Galerucella luteola*, Müll.] ; *Diachasma* (*Opius*) *crawfordi*, Vier., from Mexico, and *Opius anastrephae*, Vier., from Porto Rico, both against fruit-flies ; and *Collyria calcitrator*, Grav., from Canada against the black wheat-stem sawfly [*Trachelus tabidus*, F.]. Numerous beneficial insects were imported into Porto Rico, including : *Plaesius javanus*, Er., from Fiji against the banana root weevil [*Cosmopolites sordidus*, Germ.] ; *Dasyscapus parvipennis*, Gah., from Trinidad against the cacao thrips [*Selenothrips rubrocinctus*, Giard] ; and *Metagonistylum minense*, Tns., against the sugar-cane borer [*Diatraea saccharalis*, F.].

The length of exposure necessary to kill all stages of the cigarette beetle at 10, 15, 20, 30, 32, 36 and 40°F. varied from 0·04 day at 10°F. for the eggs to 40 days at 40°F. for the adults. Anhydrous calcium arsenates are apparently not toxic to silkworms [*Bombyx mori*, L.] and bean plants, but where water of crystallisation is present, the toxicity is decidedly higher. The extent of loss of toxicity of tricalcium and tetracalcium arsenates resulting from the application of heat depends on the duration and temperatures of heating and on moisture conditions during heating. Bruchids infesting peas and beans were killed within the seed after fumigation for 6 hours under reduced pressure with volatilised nicotine.

MARSH (F. L.). **Ecological Observations upon the Enemies of *Cecropia*, with Particular Reference to its Hymenopterous Parasites.**—*Ecology* **18** no. 1 pp. 106–112, 2 figs., 4 refs. Lancaster, Pa, January 1937.

As a result of a study in the Chicago area of the interrelations of *Samia cecropia*, L., and its food-plants and natural enemies, and particularly of the effect of its Hymenopterous parasites and hyper-parasites, the author discusses the biotic balance among them. A table, representing the results obtained from a dissection of 2,741 cocoons of the moth, gives a quantitative analysis of the biological

influences that acted on them. The Ichneumonid, *Spilocryptus extrematis*, Cress., appears to be one of the most important influences in regulating the emergence of the moth, parasitising 22·8 per cent. of all cocoons.

BAKER (W. L.) & CLINE (A. C.). **A Study of the Gypsy Moth in the Town of Petersham, Mass., in 1935.**—*J. For.* **34** no. 8 pp. 759–765, 2 diagr., 2 refs. Washington, D.C., August 1936. [Recd. June 1937.]

Since it was first observed in Massachusetts, 45 years ago, the gypsy moth, *Lymantria* (*Porthetria*) *dispar*, L., has spread until it now infests many trees over a considerable part of New England. It often causes severe defoliation, but there are large areas in which it occurs without becoming very injurious, apparently because of the absence of certain types of forest growth necessary for its increase to epidemic numbers. It is known that the leaves of different species of trees are preferred by the different instars of the larvae, and some are unpalatable to all instars [*R.A.E.*, A **3** 668]. Species favoured by larvae of all ages are the oaks, poplar, grey birch [*Betula populifolia*], alder, willow and apple. White pine [*Pinus strobus*] is refused by the young larvae but readily attacked by the older ones. For 10 years, observations have been made on the infestation of $\frac{1}{5}$-acre plots; a graph based on data from 104 of these shows that the amount of defoliation and the numbers of egg clusters per acre are dependent on the percentage of favoured trees in the stand.

In 1935, an outbreak occurred for the first time in an area of 22,000 acres in central Massachusetts in which there were about 5,000 separate stands, and a study was made of the dependence of the moth on favoured trees and the possibility of control by sylvicultural practices. There were 82 defoliated areas, of which 81 were examined. In all these, heavy defoliation was invariably associated with a high percentage of favoured trees in the stand. Complete defoliation was not found in any instance where favoured trees constituted less than 50 per cent. of the stand; in 56 of the defoliated areas, oak, grey birch and poplar comprised more than 75 per cent. [*cf.* **24** 293]. The older larvae are particularly liable to migrate from defoliated hardwoods to conifers, which are unable to refoliate [*cf.* **23** 620].

As a result of these observations, recommendations are given for sylvicultural control in the region studied. Sites for conifer plantations should be thoroughly cleared before planting. Hardwood "fillers" should be kept below the level of the conifers, and if comprised of grey birch, would probably be better eradicated. Understories of natural origin should be similarly treated. Overstories of birch or poplar, while furnishing protection to the conifers against the white pine weevil [*Pissodes strobi*, Peck], facilitate attack by *L. dispar*. Their elimination should be carried out in two steps. The hardwood should be reduced as far as possible without exposing the conifers to the risk of bending or breaking under loads of snow or ice; but should only be cut and removed when a few years have elapsed and the stems of the conifers are sufficiently strong. In mixed stands of pine and the more valuable hardwoods, a reduction of the oak foliage to about half that of the pine should prevent heavy defoliation of the latter. Where conditions justify the complete elimination of the oak, any considerable space left by cutting might be planted with conifers. The proportion

of oak may also be reduced and replaced by such trees as white ash, hard maple and paper birch [*Betula papyrifera*], or the foliage of the oak reduced to somewhat less than half the total for all the hardwoods in a given group. Reduction of oak foliage in this proportion should also be carried out in stands of better mixed hardwoods, necessitating annual cuttings over a period of years. Where conifers grow next to stands of susceptible hardwoods, the clearing of a protective strip about 100 feet wide should be sufficient to prevent any serious defoliation along the margin of the conifer stand. As stands of grey birch and poplar provide the chief sources of infestation, these should preferably be cut and replaced by species that can be sawn for timber.

KEEN (F. P.). **Relative Susceptibility of Ponderosa Pines to Bark Beetle Attack.**—*J. For.* **34** no. 10 pp. 919–927, 4 refs. Washington, D.C., October 1936. [Recd. June 1937.]

In recent years, *Dendroctonus brevicomis*, Lec., has caused very severe mortality of *Pinus ponderosa* in the western United States, and attention has been devoted by various workers to the question of the relative susceptibility of different types of this pine [*cf. R.A.E.*, A **21** 97], with a view to improvement in the management of the stands and the selection of trees for salvage. It has been found that the beetles show a decided preference for trees that are slow-growing, those between 20 and 30 inches in diameter, and those grown on the poorer sites, selection being most marked when infestation is endemic or increasing. These conclusions were confirmed by extensive studies made by the author from 1927 to 1932 in southern Oregon and northern California. The trees were classified in age groups 1–4, according to whether they were young, immature, mature, or overmature, the approximate ages for the groups being less than 75, 75–100, 150–300, and more than 300 years, respectively. Each age group was subdivided into four classes (A–D) according to the vigour and abundance of the foliage of the crown, those in D having the weakest crowns with foliage sparse and scattered or only partly developed. Thus 16 types were analysed for relative susceptibility. From 1928 to 1931, inclusive, 27,465 trees killed by the beetles on approximately 15,000 acres of sample plots were classified and compared with a mechanically selected sample of 22,428 living trees, and the total number of surviving trees was determined in 1932. During the 4-year period, the highest loss from *Dendroctonus* attack in any one year on one plot was 880 board-feet per acre over 640 acres and the lowest 70. The average on all plots during the period was 300 board-feet per acre annually. The mortality ratio, obtained by dividing the percentage occurrence of losses due to the beetle in a given type by the percentage occurrence of that type in the original stand, gives a measure of relative susceptibility with 1 as the standard. The mortality ratio for the 16 types varied from 0·17 to 2·5. In each age group, susceptibility increases with a decrease in crown vigour, except that the C class appears to be more susceptible than the D class in the three older age groups. Although the number of trees of D class may not be sufficient to prove this, field observations have shown that the poorest trees are often ignored by the beetles while neighbouring trees of greater vigour are attacked, and it may be that these trees offer too little nourishment to attract the beetles.

A comparison of the relative susceptibility, in comparable crown classes, of the four age groups shows that there is a gradual increase in risk with increasing age, the mortality ratio for trees with A crowns in groups 1–4 being 0·17, 0·32, 0·41 and 0·48, respectively. Differences in age are, however, much less important than differences in crown vigour. For instance, a 4A tree, while more susceptible than younger trees with A crowns, is not nearly so likely to be killed as a 2B or 2C tree. In the region surveyed, *Dendroctonus* is carrying on a natural selection process, favouring the survival of the dominant trees. For sylvicultural purposes, trees may be arranged in susceptible, intermediate and resistant groups, which contain, respectively, the following types of trees in order of decreasing susceptibility: 1D, 2C, 4C, 3C, 1C, 3D, 4D and 2D; 4B, 3B, and 2B; 1B, 4A, 3A, 2A and 1A. If the primary purpose of a marking is to salvage valuable trees likely to be killed before they are reached in the normal course of logging, then only such types of susceptible trees as will yield a profit need be included. Trees of no value may be left, for, even if they are killed, no present convertible value has been lost. If, however, the primary purpose is to forestall outbreaks of *Dendroctonus* and reduce mortality rates, then all the more susceptible types should be removed and the stands sufficiently thinned to give noticeable release and growth stimulation to the reserve. There is no proof, however, that such stands will be immune from further losses, as during epidemic periods trees of all types may be killed with little regard to apparent vigour. On poor sites, in "fringe type" timber, and on areas suffering from the effects of drought, all types of trees are reduced in vigour and tend to become nearly equal in susceptibility. On such problem areas, only the youngest and most vigorous trees should be left as a reserve.

Howard (N. F.) & Landis (B. J.). **Parasites and Predators of the Mexican Bean Beetle in the United States.**—*Circ. U.S. Dep. Agric.* no. 418, 12 pp., 3 figs., 18 refs. Washington, D.C., December 1936.

The parasites, predators and diseases of *Epilachna varivestis*, Muls., are briefly discussed, and tabulated lists of them are given. One shows those actually observed attacking it in the field in the United States and Mexico with their distribution in the various States of the former country; the others show the distribution in the United States of some observed attacking it in Mexico only, and of experimental predators. In each list, the stages of the beetle attacked and the sources of the records are indicated.

Frings (H. W.) & Frings (M. S.). **Magnesium Sulphate—a new Insecticide.**—*Science* **85** no. 2209 p. 428, 1 ref. New York, 30th April 1937.

It is stated that Dr. V. R. Haber discovered several years ago the insecticidal properties of Epsom salts (magnesium sulphate). His tests showed that it is effective in the control of *Epilachna varivestis*, Muls. (*corrupta*, Muls.) on beans. When used as a spray in the proper concentration, it is easily applied, easily removed in preparing beans for cooking, and harmless to man if consumed. In preliminary experiments against grasshoppers, a bran bait containing 15 per cent.

molasses and 20–25 per cent. magnesium sulphate, with enough water to moisten, appeared to be as effective as a 5 per cent. arsenic bait.

OSBORN (H. T.). **Studies on the Transmission of Pea Virus 2 by Aphids.** —*Phytopathology* **27** no. 5 pp. 589–603, 4 figs., 13 refs. Lancaster, Pa, May 1937.

In experiments in New Jersey, pea virus 2 [*cf. R.A.E.*, A **23** 167] was transmitted by both nymphs and adults of *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.), *M. solanifolii*, Ashm. (*gei*, auct.), and *Aphis rumicis*, L. Colonies of each Aphid were able to acquire the virus during a feeding period of 5 minutes on a diseased bean plant (*Vicia faba*) and to transmit it to a healthy one during a 5 minute period immediately following. Some colonies lost the virus during a period of 15 minutes on healthy plants. Retention of the virus for more than one hour was not demonstrated in any colonies allowed to feed on healthy plants for that time. When kept without food, *A. rumicis* retained the virus for 5 hours, *M. onobrychis* for 8 hours and *M. solanifolii*, in one instance, for 24 hours. No incubation period of the virus was observed in colonies of any of the Aphids fed for one day on diseased plants and then transferred to a succession of healthy plants for a total period of 14 days. As it is thus apparently transmitted mechanically, either on the mouth-parts or through the bodies of the insects, pea virus 2 differs from pea virus 1, which is transmitted only after an incubation period of 12–24 hours in the Aphids [**23** 166, 283] and is retained during their life [**22** 131].

WEBSTER (R. L.). **Division of Entomology.**—*Bull. Wash. St. agric. Exp. Sta.* no. 342 (Rep. 1935–36) pp. 32–34. Pullman, Wash., December 1936. [Recd. April 1937.]

Of sprays tested against the codling moth [*Cydia pomonella*, L.] on apples in Washington, phenothiazine [thiodiphenylamine] at the rate of 1 lb. in 100 U.S. gals. water was not effective [*cf. R.A.E.*, A **25** 345]. Calcium arsenate appeared to be quite as efficient as lead arsenate against the first brood, but less so against the second. When mixed with triethanolamine oleate and mineral oil, lead arsenate gave excellent results [see next paper], but, when applied in similar combinations, calcium arsenate was less effective and zinc arsenite injured the foliage. In insectary tests, 0·5 per cent. mineral oil and 2 per cent. kerosene in lead arsenate sprays killed 93·3 and 9·9 per cent. of the eggs, respectively.

Macrocentrus ancylivorus, Rohw., has been liberated against the pea moth [*Cydia nigricana*, Steph.], which it attacks experimentally [*cf.* **24** 303, 499], but no recoveries have yet been made.

MARSHALL (James) & GROVES (K.). **New Spray Combinations and how they Work.**—*Proc. Wash. St. hort. Ass.* **32** (1936) pp. 122–126, 1 fig. Pullman, Wash. [1937.]

Since 1932, experiments have been carried out to test the effectiveness of various types of lead arsenate spray mixtures against the codling moth [*Cydia pomonella*, L.] on apples in Washington [*R.A.E.*, A **23** 274]. It has been found that the most efficient arsenical spray deposits have three characters in common; they are uniformly

distributed on the fruit surface; they increase steadily in quantity as spraying is prolonged; and they are oily. In mixtures that produce such deposits, the lead arsenate flocculates in the spray tank, but flocculation also characterises many others that are much less efficient. It is thought that in the best mixtures it may be connected with inversion. An inverted codling moth spray mixture is defined as one in which a finely divided solid suspension, such as lead arsenate, is transferred completely from the water phase to the oil phase of an emulsion, to the accompaniment of breaking or inversion of that emulsion. This requires the presence of 4 substances, water, oil, lead arsenate and an agent effecting the inversion. For a spray containing 3 lb. lead arsenate per 100 U.S. gals., the optimum amount of oil is 4 U.S. pints ($\frac{1}{2}$ per cent.); less does not wet or "carry" the arsenical properly, and more wets it excessively, so that the particles tend to be flushed off the fruit surface by succeeding droplets of oil.

As a basis of comparison for the experimental results, lead arsenate used alone in 6 cover sprays is represented as allowing 50 per cent. infested fruit. Two infestations were calculated from each spray mixture, the first from a moderate dosage of 40–45 U.S. gals. per application for a tree able to bear 30 boxes of fruit and the second from a dosage of 75–80 U.S. gals. Sprays of lead arsenate alone or mixed with a colloidal spreader, soap or herring oil are almost entirely unable to build up arsenical deposit, and, except with herring oil, the deposit from the heavy applications is not increased and is sometimes decreased as a result of removal of previous deposit. With the lighter application of these mixtures, infestations are about 35–40 per cent. The 5th spray, a slightly inverted mixture of water, $\frac{1}{8}$ per cent. kerosene, lead arsenate and soap, gives rather better control, and heavy applications show higher deposits than moderate ones. The replacement of the kerosene by herring oil results in a smooth and heavy deposit, and, in addition, it is oily, whereas that from the kerosene mixture is dry and easily rubbed off. The 7th spray is similar to the 5th, but the kerosene is increased to $\frac{1}{2}$ per cent., giving a much heavier deposit. To the 8th spray is added $\frac{1}{8}$ per cent. herring oil and $\frac{3}{8}$ per cent. kerosene with triethanolamine oleate, giving $\frac{1}{2}$ per cent. total oil, which is sufficient for satisfactory inversion; as $\frac{1}{2}$ per cent. herring oil would probably be toxic to foliage, kerosene is mixed with it. The 9th spray tested, lead arsenate with $\frac{1}{2}$ per cent. mineral oil (paste emulsion), has a high ovicidal value, which in light applications more than compensates for its poor covering qualities and slight arsenical build-up. With heavy applications, however, the 8th spray is much more effective. The 10th and final spray investigated, known as W.C.S. Dynamite, is a combination of lead arsenate, $\frac{1}{2}$ per cent. petroleum oil, oleic acid and either triethanolamine or ammonia. In addition to its high ovicidal value, this inverted mixture in heavy applications is capable of building up an enormous load of arsenical in a smooth and oily film and of reducing infestation to less than 1 per cent., whereas lead arsenate alone, even when applied twice as heavily, does not reduce infestation to less than 45 per cent. This mixture is difficult to handle and shows a tendency to cause arsenical injury. It should not be applied later than 1st July, on account of the difficulty of residue removal, or in the first cover spray, as $\frac{1}{2}$ per cent. oil in any form at that time may bring about serious fruit drop. It is not recommended for use on pears, as it is thought to impair their keeping qualities.

FLINT (W. P.) and others. **Entomology Investigations.**—*Rep. Ill. agric. Exp. Sta.* **48** (1934–35) pp. 154–182. Urbana, Ill., 1936.

An account is given of work against insect pests in Illinois during 1934–35. At the end of 1934, work on the breeding of strains of maize [*cf. R.A.E.*, A **24** 115] resistant to the European corn borer [*Pyrausta nubilalis*, Hb.] was brought to a conclusion; the results of the tests in that year are tabulated. Promising results were obtained from preliminary experiments to find strains resistant to the corn ear worm [*Heliothis armigera*, Hb.]. The severe infestation of maize and other cereals by chinch bugs [*Blissus leucopterus*, Say] that started in 1930 reached its maximum in 1934, when damage to maize alone was estimated at £6,000,000. The use of creosote barriers [*cf.* **23** 464] saved maize to the value of about £684,110. Large numbers of the bugs survived the winter, but heavy rains in spring and early summer reduced the population in 1935, so that only scattered damage occurred. Cutworms caused heavy losses of soy beans but were controlled by means of a bait containing 25 lb. bran, 1 lb. Paris green or white arsenic, and 2 U.S. qts. cheap lubricating oil (S.A.E. 20 or 30), which in tests killed 79–95 per cent. in 48 hours [*cf.* **23** 318]. This bait is effective for longer than that previously used, which contained molasses and water, and apparently may be stored already mixed. The larvae of *Utetheisa bella*, L., completely destroyed the seed of *Crotalaria incana* on one planting and were abundant in others, but other species of *Crotalaria* appeared to be relatively free from attack.

Owing to the weather in 1934 and to the failure of the crop in most districts, infestation of peaches by the plum curculio [*Conotrachelus nenuphar*, Hbst.] was very light in 1935, and one or two sprays were sufficient to give control. Twig collection showed that 20 per cent. of the larvae of the oriental fruit moth [*Cydia molesta*, Busck] on peach were parasitised; parasitism by *Macrocentrus ancylivorus*, Rohw., varied from 3·6 to 40–50 per cent. In Illinois, peach trees treated with oil-impregnated dusts are superior in growth and vigour to sprayed ones. The most effective dust against the plum curculio consisted of 60 lb. sulphur, 25 lb. lime, 10 lb. lead arsenate and 5 lb. light-grade lubricating oil; for the control of *C. molesta* during the three weeks preceding harvest, satisfactory results were given by one of 60 lb. sulphur, 35 lb. lime, and 5 lb. of the same oil. Slightly better control resulted if 300-mesh talc was substituted for half the lime in each formula. In 1934 the average infestation of apples by the codling moth [*Cydia pomonella*, L.] was 8·8 per cent. in orchards sprayed with lead arsenate and oil, and 21·2 per cent. in those sprayed with lead arsenate and lime. A mixture of 3 U.S. qts. soy bean oil with 3 lb. lead arsenate gave the lowest percentage of infested apples on the experimental plots, but when applied in hot weather it injured the foliage. Cryolite with oil gave good control, but some fluorine remained on the fruit. In one orchard where the trees on 10 acres were banded and those on 20 left unbanded, the average infestation at harvest was 17·2 and 29·7 per cent., respectively. An examination of 149 orchards in the autumn of 1934 showed that 42 per cent. of the apple orchards and 71 per cent. of the peach orchards were moderately or severely infested with San José scale [*Aonidiella perniciosa*, Comst.], as compared with 26 and 32 per cent., respectively, in 1933. In the spring, the apple flea-weevil [*Rhynchaenus pallicornis*, Say] appeared in moderate numbers.

Dormant oil sprays applied over 5–10 year periods to relatively young apple trees have not affected their growth appreciably. Summer applications of an unsaturated oil of 32 seconds viscosity did not injure fruit or foliage, but one of 83 seconds injured both. Saturated oils caused negligible injury.

Taeniothrips simplex, Morison (*gladioli*, Mlt. & Stnw.), has reduced the commercial production of gladiolus flowers by as much as 75–85 per cent. in some cases during the last 2 years. The most satisfactory measure against *Tarsonemus latus*, Banks, on greenhouse plants was dusting with 300-mesh sulphur. Effective control of red spiders on conifers and shrubs was given by two dusts of powdered glue at intervals of 4–5 days, applied when the trees were wet. A single application of a spray containing 1 fl. oz. nicotine sulphate and 2 fl. oz. penetrol (or 3 oz. soap) in 3 U.S. gals. water gave control of *Dendrothrips ornatus*, Jabl., on privet.

Stoner (D.). **Reptiles and Amphibians in Relation to Celery Insects in the Sanford, Florida, District.**—*Florida Ent.* **19** no. 4 pp. 49–53, 1 fig. Gainesville, Fla, February 1937.

Brief notes are given on some reptiles and amphibians that might destroy insects, particularly *Phlyctaenia rubigalis*, Gn., on celery in Florida, and on the results of analysis of the stomach contents of a few of them. The commonest was *Bufo terrestris*. In stomachs of 15 examples of this toad only one larva of *P. rubigalis* was found, but cutworms and earwigs comprised about 9 and 44 per cent. of the contents, respectively, and beetles about 35 per cent.

Ginsburg (J. M.) & Kent (C.). **The Effect of Soap Sprays on Plants.**—*J. N. Y. ent. Soc.* **45** no. 1 pp. 109–113, 7 refs. New York, N.Y., March 1937.

The following are the authors' summary and conclusions: Greenhouse, garden, ornamental and orchard plants were sprayed with various concentrations of coconut oil soap in order to determine the maximum concentration that can be applied without injury. The results suggest the following conclusions: Concentrations of 0·25 per cent. soap caused no injury to blossoms or foliage of any one of the plants tested. Concentrations of 0·5 per cent. produced no injury to foliage, stems or buds, but caused injury to delicate flowers. Concentrations of 1 per cent. produced no injury to orchard trees, but produced injury to many greenhouse and garden plants. Concentrations of 2 per cent. produced injury to most of the plants tested.

Fox (H.). **Seasonal Trends in the Relative Abundance of Japanese Beetle Population in the Soil during the Annual Life Cycle.**—*J. N. Y. ent. Soc.* **45** no. 1 pp. 115–126, 2 figs. New York, N.Y., March 1937.

The following is largely taken from the author's summary: Field surveys of the abundance of the soil-inhabiting population of the Japanese beetle [*Popillia japonica*, Newm.], conducted throughout the greater part of each year in a group of 8 stations situated in New Jersey within 12 miles of the original point of entry of the insect and covering 7 consecutive years, reveal certain clearly defined trends in the course of its annual life-cycle that are confirmed by surveys in a

more recently infested district about 25–40 miles from the original centre of infestation.

A rapid increase in the population, coincident with the season of active deposition of eggs, begins in June and extends through the summer, maximum abundance being reached early in September. The population decreases rapidly until mid-October, and it then remains practically stationary until about 1st May in the next year. It then again decreases rapidly until June, when adult emergence begins.

The absence of any significant reduction during the winter is attributed largely to the inhibition by winter temperatures of the activities of soil organisms parasitic or predatory on the larvae. Rapid reductions in population are normally coincident with the occurrence of warm weather, which suggests that biotic agencies are the cause. After 15th June, the reduction is largely due to the emergence of adults from the ground, but before that date all reductions result from the various destructive agencies to which the immature stages of the insect are exposed in the soil, among which various native soil-dwelling organisms (pathogenic bacteria, fungi, protozoa, and parasitic Nematodes) appear to play a major part, and birds and other surface-feeding animals a minor one.

Reductions in populations of the beetle due to its imported parasites have been too strictly local to be of significance in bringing about the general seasonal reductions recorded in this paper, although recent developments in the biological control of the beetle are more promising.

Felt (E. P.) & Bromley (S. W.). **Observations on Shade-tree Insects and their Control.**—*J. econ. Ent.* **30** no. 1 pp. 71–75. Menasha, Wis., February 1937.

The pests mentioned in these notes were all observed in south-western Connecticut in 1936. An undescribed mealybug was found infesting yew (*Taxus cuspidata*) in June, in limited numbers and over a limited area. It did not form the masses and festoons characteristic of *Pseudococcus comstocki*, Kuw., which was abundant on *T. cuspidata* in September. Punctures on the needles of various pines, which were subsequently invaded by a saprophytic fungus causing yellow and red spotting, were attributed to the Psyllid, *Trioza tripunctata*, Fitch, which migrates to pines in autumn after the leaves of blackberry have fallen, and reappears on the needles in spring after hibernation. During 1935 and 1936, limes were so severely infested by *Myzocallis* (*Therioaphis*) *tiliae*, L., that their replacement by other species of ornamental trees was considered. In comparative tests against *Aphrophora parallela*, Say, on pines, a pine oil emulsion (Palustrex) with nicotine sulphate (2 : 1 : 800), and a pyrethrum soap (Red Arrow) with crystal potassium oleate (1 : 2 : 400) gave complete control; nicotine sulphate with summer oil (1 : 4 : 800) gave only partial control. None of these injured the foliage.

Malacosoma americana, F., and *Alsophila pometaria*, Harr., were abundant in the spring but did not reach the outbreak proportions of 1935 [*R.A.E.*, A **24** 387; **25** 374]. When lead arsenate is added to the dormant oil spray for the control of the young larvae of *M. americana*, the spray should be delayed to correspond as nearly as possible with hatching, though when the concentration of oil was increased from 1 : 16 to 1 : 10, good control was obtained even when the application was made some time earlier. Sunoco oil (1 : 10)

and lead arsenate, applied in the spring before the leaves separated in the bud, did not injure apple trees and gave excellent control of *Malacosoma* and fair control of *Alsophila*. Natural enemies in 1935 [*cf.* **25** 374] and late frosts in 1936 were probably responsible for the decrease of infestation by *Alsophila*. Mortality of larvae of *Malacosoma* during 1935 was attributed to wilt and fungous diseases (30 per cent.), Hymenopterous and Tachinid parasites, chiefly *Pimpla* (*Ephialtes*) *pedalis*, Cress., *P.* (*Iseropus*) *coelebs*, Walsh (25 per cent.), and starvation, malnutrition, overcrowding and predators (20 per cent.). The numbers of *Malacosoma* were also probably reduced by the unattractive condition of wild cherry and apple trees for oviposition, owing to defoliation by *Alsophila*, which also deterred *Argyrotoxa semipurpurana*, Kf., on oak. In tests with non-poisonous materials in summer oil emulsion (1 : 200), one or two commercial brands of derris gave excellent kill of *Malacosoma* at the rate of 3 lb. 4 per cent. powder to 100 U.S. gals. spray. Control of *Alsophila* was not quite so good. Cubé [*Lonchocarpus*] appeared to be slightly less toxic than derris. Pyrethrum powder in oil emulsions was less toxic than pyrethrum extract and soap or than derris.

FILMER (R. S.). **Poisoning of Honeybees by Rotenone-Derris Dusts.**—*J. econ. Ent.* **30** no. 1 pp. 75–77. Menasha, Wis., February 1937.

On 21st July 1936, the ground in fields of lima beans in New Jersey was covered with dead bees near hives where 37 colonies of bees had been placed on the 17th, and a few sick and crawling ones were leaving the hives. Both field and nurse bees died. No dead or discoloured larvae were found, but, as the unsealed brood had been neglected, the older larvae were wriggling on the cells. In some colonies, only the queen and a few young bees remained. Lima beans, extending over 5,000–6,000 acres, which formed the principal crop in the neighbourhood, had been dusted with a 0·75 per cent. rotenone dust containing 20–25 per cent. sulphur and about 15 per cent. copper from an aeroplane on the evening of 19th July and morning of 20th July, when the beans as a whole were not in bloom. They were coming into flower on the 22nd, and it is probable that some plants may have been in bloom when dusted. The nearest field in full bloom was ¾ mile away. No instance of arsenical dusting in the neighbourhood was traced, and analysis of dead bees failed to show the presence of arsenic. In several apiaries about 1 mile away, bordering on fields of young beans that had been dusted on 19th July but were not in bloom, there were no signs of poisoning.

It was thought that the rotenone might have poisoned the nectar of the few open flowers or have drifted to fields in full bloom. To test the theory, bees were allowed to feed on dilutions of sugar syrup containing rotenone in the proportions of 1 : 2500, 1 : 1250, 1 : 625 and 1 : 317. The colony fed on the 1 : 2500 solution built up normally, but in the case of the other concentrations, bees showed symptoms of poisoning on the following day and practically all died within 72 hours. The symptoms were similar to those of arsenical poisoning, bees crawling from the hives with the abdomen in many cases greatly distended. All bees dusted with 0·75 per cent. rotenone and placed in clean cages and others placed in cages of which the floor had been dusted with a light coating of 0·75 per cent. rotenone died within 24 hours.

DOHANIAN (S. M.). **Life History of the Thrips Parasite *Dasyscapus parvipennis* Gahan and the Technic for breeding it.**—*J. econ. Ent.* **30** no. 1 pp. 78–80, 6 refs. Menasha, Wis., February 1937.

The history, hosts and distribution of *Dasyscapus parvipennis*, Gah., which has recently been established in Trinidad for the control of *Selenothrips* (*Heliothrips*) *rubrocinctus*, Giard, are briefly reviewed and notes are given on its life-history and the technique of breeding it [*R.A.E.*, A **24** 304]. In February 1936, nearly 4,000 immature thrips were exposed in Trinidad to 61 females of *D. parvipennis*, and from these, 1,556 pupae of the parasite were obtained, all of which were shipped by air to Porto Rico. About 75 per cent. emergence resulted from pupae allowed to remain on the leaf on which they pupated and from others attached to heavy cardboard by means of plain water, 67 per cent. from pupae attached with gum arabic, and 55 per cent. from pupae placed on the moistened glue on the back of a postage stamp. The adults were liberated at the western end of the Island, and three months later the first recoveries were made. The introduction of this parasite into the United States for the control of *Thrips tabaci*, Lind., and *S. rubrocinctus* seems desirable.

GUY (H. G.) & SCHMITT (J. B.). **Repellents for Japanese Beetle.**—*J. econ. Ent.* **30** no. 1 pp. 81–82, 4 refs. Menasha, Wis., February 1937.

A field experiment was undertaken in an apple and peach orchard in Delaware in 1936 to compare the repellent action on *Popillia japonica*, Newm., of sprays containing 3 lb. derris, 4 lb. tetramethyl thiuram bisulphide or tetramethyl thiuram monosulphide [*R.A.E.*, A **24** 546], 20 lb. hydrated lime or 4 lb. thiodiphenylamine per 100 U.S. gals. Adhesives of the resin or resin residue types [*cf.* **24** 727], were used with all sprays, and other adhesives also with the lime. Three sprays, at the rate of 3·5 U.S. gals. per tree, were applied on 2nd July (before the beetles appeared in large numbers), 16th July and 30th August. None caused foliage injury.

Tetramethyl thiuram bisulphide gave the best protection. Good results were obtained with derris, tetramethyl thiuram monosulphide and thiodiphenylamine. All mixtures of hydrated lime were inferior, and rendered early peaches unfit for market. As an adhesive for it, 3 lb. aluminium sulphate [**24** 529] was better than 3 lb. resin residue emulsion or 1·5 U.S. pt. menhaden fish oil. The synthetic compounds and derris left no conspicuous residue.

HARMAN (S. W.) & REED (T. W.). **Codling Moth Control with Lead Arsenate Substitutes.**—*J. econ. Ent.* **30** no. 1 pp. 82–86. Menasha, Wis., February 1937.

In field tests in 1936 in New York, lead, zinc and calcium arsenates, all at the rate of 3 lb. per 100 U.S. gals., thiodiphenylamine (phenothiazine), at 4 lb., and 4 nicotine sprays were compared for the control of the codling moth [*Cydia pomonella*, L.] on apple. In all cases, about 1 U.S. gal. of liquid was allowed per bushel of fruit at each application. As a spreader for the arsenical sprays, ½ lb. skim milk or 1 lb. soybean flour was used per 100 U.S. gals.; 4 lb. soybean flour was used with thiodiphenylamine. All trees were sprayed with lime-sulphur and lead arsenate at the delayed-dormant, pink and calyx stages, and

then received 5 or 6 summer sprays according to variety, applied between 8th July and 12th August. The weather was extremely hot and dry, and sulphur spray residue caused serious injury to fruit and foliage. This made it difficult to detect minor injury due to insecticides. The only important injury was caused by calcium arsenate. It became noticeable when the drought was broken, and trees sprayed with basic calcium arsenate (less than 0·75 per cent. soluble arsenic content), used in paste form alone and in combination with 3 and 9 lb. hydrated lime, had lost about 100, 50 and 10 per cent. of their leaves, respectively, by mid-October, while those sprayed with 3 lb. of a proprietary calcium arsenate alone and in combination with 3 and 9 lb. lime had lost about 50 and 5–10 per cent. The basic calcium arsenate, which gave good coverage and the residue of which was easy to remove, was considerably more effective than the commercial brand; the two, each in combination with 9 lb. lime, had respective efficiencies of 93·3 and 78·4 on one variety of apple and 97·8 and 67·2 on another, the corresponding figures for lead arsenate with 2 lb. lime being 99·2 and 96·5. Of the nicotine sprays tested, ¾ U.S. pt. nicotine sulphate with 5 lb. B.S. Fixator (composed largely of bentonite) per 100 U.S. gals. gave the best results, with an efficiency of 95·2 per cent., compared with lead arsenate 99·2 per cent. The nicotine sprays left no residue, but are expensive. On the same variety, thiodiphenylamine had an efficiency of 90·6 per cent., but left a dark and dirty-looking residue. The efficiency of basic zinc arsenate with 2 lb. hydrated lime was 91 per cent. It left a film of residue not unlike that left by lead arsenate.

MUIRHEAD (D. M.). **Problems in Termite Control.**—*J. econ. Ent.* **30** no. 1 pp. 87–91. Menasha, Wis., February 1937.

An account is given of the ways in which various types of buildings in the north-eastern United States were protected from infestation by termites [*Reticulitermes flavipes*, Kollar] by the introduction of metal shields [*cf. R.A.E.*, A **17** 730] and the structural alterations involved, together with a brief note on the treatment of wooden frame houses in which permanent protection is not required, by substituting concrete or metal for wood in contact with the ground.

SANDERS (G. E.). **Termite Control in Northeastern United States.**—*J. econ. Ent.* **30** no. 1 pp. 92–94. Menasha, Wis., February 1937.

Damage to buildings by termites [*Reticulitermes flavipes*, Kollar] has been increasing in the north-eastern United States since 1932. If the attack is noticed in time, severe injury can be averted. When new buildings are being constructed, copper shields should be put between the foundation and the wooden parts. For existing ones, chemical soil treatment or a combination of this and copper shields is recommended [*cf. R.A.E.*, A **24** 387].

TURNER (N.). **Relation of State Workers to Commercial Termite Control Companies.**—*J. econ. Ent.* **30** no. 1 pp. 94–98, 3 refs. Menasha, Wis., February 1937.

Commercial companies interested in the sale of chemicals for the control of termites allege that metal shields do not prevent infestation by *Reticulitermes flavipes*, Kollar, or alternatively that shields cannot

be successfully introduced into existing buildings. Investigations have failed to yield evidence that this is so. A list of misleading statements drawn from the advertisements of such companies is given.

KASTON (B. J.) & RIGGS (D. S.). **Studies on the Larvae of the Native Elm Bark Beetle.**—*J. econ. Ent.* **30** no. 1 pp. 98–108, 7 figs., 6 refs. Menasha, Wis., February 1937.

The following is the author's summary of the results of an investigation on the development of larvae of the elm bark-beetle, *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., in Connecticut: It is not possible to determine the number of instars by measuring the head capsules [*cf. R.A.E.*, A **20** 579; **21** 541] of mixed lots of larvae taken at random from various localities in the field. If the measurements are considered separately by families, the evidence indicates that some larvae go through six instars and some through five. A special device is described which allowed the daily observation of larvae reared from hatching to pupation [in pieces of elm bark between sheets of glass]. In this way, the exact number of instars and duration of stadia were obtained for each larva. Six, seven and perhaps eight instars appear to be the usual number under these conditions, though in one family nine to twelve occurred. There is a positive correlation between the number of instars and the duration of the entire larval period. The rate of tunnelling was found to be quite variable with different larvae. Accompanying each ecdysis there is a period of almost a day during which the larva does not feed, and preceding pupation a period of about 3½ days during which the tunnel is not lengthened.

RICE (P. L.). **Effect of Moisture on Emergence of the Ragweed Borer *Epiblema strenuana* Walker, and its Parasites.**—*J. econ. Ent.* **30** no. 1 pp. 108–115, 4 figs., 5 refs. Menasha, Wis., February 1937.

The following is based on the author's summary: Published information [*R.A.E.*, A **15** 136, 247; **24** 475] shows that a lack of moisture in the form of free water may retard or arrest insect development, prevent return to an active state after hibernation or cause a change in life habits, even in the presence of atmospheric moisture. During 1936 in Delaware, two lots of ragweed [*Ambrosia*] each containing approximately 20 overwintered larvae of *Epiblema strenuana*, Wlk., were exposed to each of 19 different moisture treatments. Records of adult emergence of *E. strenuana* and parasites were made each week, and the stage reached by insects that failed to attain maturity was noted in the autumn. A total adult emergence of 100 per cent. resulted from lots of insects that were soaked for one minute at weekly intervals throughout the season from 29th April, while no adults were produced in lots that received no contact moisture or were soaked only once, on 22nd July. When soaking was discontinued before 1st June or not started until 1st July, adult emergence was less than 60 per cent., whereas if it was continued later or started earlier emergence was over 90 per cent. The percentages of adults that emerged after a single soaking during the first part of June (the time when *E. strenuana* normally pupates) and 3 weeks earlier and later, were 50, 26·2 and 17·9. Transformation to the adult stage was delayed when contact moisture applications were started late. The minimum

number of one-minute wettings necessary to produce a high percentage of adult emergence was not determined. It is apparent, however, that several would be required. The maximum percentage produced by one soaking was 50. High humidity alone did not induce normal emergence. Only one insect out of 41 periodically exposed to saturated air attained the adult stage. When larvae were kept out of doors or placed out of doors in rainy periods only, the respective percentages of adult emergence were 87·2 and 76·9. The failure of these almost natural conditions to produce maximum emergence may be due to low rainfall during May and early June. Lack of contact moisture usually arrests the development of *E. strenuana* in the larval stage. More than 95 per cent. of the borers that failed to attain maturity died as full-grown larvae. No definite conclusions on the effect of moisture on the development of parasites [*cf.* **24** 475] can be drawn from the experiments in 1936.

Ditman (L. P.). **Observations on Poison Baits for Corn Ear Worm Control.**—*J. econ. Ent.* **30** no. 1 pp. 116–118. Menasha, Wis., February 1937.

Continuing the work on baits for the control of the corn ear-worm [*Heliothis armigera*, Hb.] on sweet maize that has been in progress in Maryland during the past 10 years [*R.A.E.*, A **22** 318; **25** 406, etc.], experiments were carried out in September 1936 with a bait composed of 15 lb. cane sugar, 1½ lb. sodium arsenite and 2 U.S. gals. water, to investigate various methods of application. In one ¼-acre plot, baits were placed on 2nd September at intervals of 20 ft. along the four sides in metal containers with a gauze trough on top, so arranged that the moths could feed without being drowned. From 5th to 9th September, the bait was sprayed daily on plants in two outside rows. Oviposition counts were made before treatment, while the traps were in operation, and while both traps and sprays were being used. The average numbers of eggs per ear were 4·5 on 31st August, 2 on 5th September and 0·26 on 9th September, and the percentage of ears free from eggs 6·6, 40 and 80, respectively. When the baits were being used, dead moths were picked up at fairly regular intervals. They were usually within 4 or 5 ft. of the poisoned plants. The numbers collected increased from 13 on 3rd September to 189 on 11th and decreased only slightly on the 13th and 15th. Two lots of dead moths were found to contain an average of 0·0051 and 0·0056 mg. arsenic per moth, respectively. In a second plot, about ⅛ acre in extent, one application of bait-spray was made to a row on each side to determine the residual effect. Dead moths were picked up daily for a week; the total number recovered was 98, the daily figures varying from 12 on the second day to 19 on the fifth day after application. In a second field of 3 acres, 60 plants on one side were sprayed on 5th September. In daily collections until 13th September, 249 moths were recovered. The fewest (27) were collected on the eighth day after application and the most (50) on the third day. When oviposition counts were made on the eighth day, an average of 1·6 eggs per ear was found on 100 ears near the treated plants and 0·6 egg per ear on the far side of the field and in an adjacent field. In a third field, about 1 acre in extent, an application of bait was made to one row around the field and to a row in the middle, on 13th September, by dipping the silks into a can of bait. This method is economical and simple. On the second

day, 27 dead moths were picked up and on the fourth, 117. Oviposition counts on 12th September showed 2·5 eggs per ear, and on 16th September 0·95 per ear. One U.S. qt. bait should be sufficient to treat an acre of sweet maize by the dipping method. More is required for spraying.

GAINES (J. C.). **Cotton Flea Hopper Control Tests using the Latin Square Plat Arrangement and Analysis of Variance.**—*J. econ. Ent.* **30** no. 1 pp. 119–125, 4 refs. Menasha, Wis., February 1937.

An account is given of experiments in Texas in 1935 on the application of certain dusts to cotton for the control of *Psallus seriatus*, Reut. The Latin square method of arranging the plots was used. In this arrangement, each treatment is repeated as many times as there are treatments, and none occurs more than once in the same row or the same column. The plots each covered 0·05 acre and were 7 ft. apart. The significance of the various results is demonstrated mathematically. With two fields laid out as Latin squares, it is possible to determine the significance of the differences between the various treatments, whereas, when one-acre plots with little duplication are used, as is the usual practice, it is not possible.

EWING (K. P.) & MCGARR (R. L.). **Recent Insecticide Experiments to control Cotton Flea Hopper at Port Lavaca, Tex.**—*J. econ. Ent.* **30** no. 1 pp. 125–130. Menasha, Wis., February 1937.

Experiments with several new insecticides for the control of *Psallus seriatus*, Reut. (cotton fleahopper) were carried on in Texas in cages in 1933–35 and in the field in 1935 [*cf. R.A.E.*, A **24** 413]. The food plant used in the cages [*cf.* **19** 670] was *Croton capitatus*. The percentage mortality due to the dusts was ascertained by comparison with mortality in control cages, a series of counts being made in the course of 4 days. Averages of 404, 225 and 316 adults and 220, 170 and 203 nymphs were treated with each insecticide in 1933, 1934 and 1935, respectively. Derris root, cubé [*Lonchocarpus*] root and other mixtures containing rotenone (usually 4 per cent. but in one case 50 per cent.) and phenothiazine [thiodiphenylamine] were ineffective. A commercially prepared pyrethrum dust containing an activator and 0·5 per cent. total pyrethrins caused 75 per cent. mortality of adults and 57·7 per cent. of nymphs. The addition of sulphur to pyrethrum increased the effectiveness against nymphs, but decreased it against adults (72 per cent. and 32 per cent. kill, respectively, when 9 parts sulphur were used to 1 part pyrethrum). In 1934, the highest kill of both adults and nymphs (82·8 per cent. mortality of both stages) was obtained with a mixture of 1 part Paris green and 5 parts sulphur.

This combination was tried in triplicate tests in cotton fields in 1935 in the proportions of 5 : 95, 10 : 90 and 20 : 80. In each test, 1 acre was dusted with each mixture and 1 acre left as a control. Production was greatest on plots dusted with the 10 : 90 mixture, the 20 : 80 dust, which gave the highest kill, having an injurious effect on the plants. The increased yield was considerable only when infestation was heavy and applications were started early in the season. Under these conditions, 2 applications of Paris green and

sulphur (10 : 90) gave a net profit of about £4 12*s.* per acre and 80 per cent. of the crop was harvested by 12th August, whereas on the control plot, only 17 per cent. had been harvested by that date.

Ewing (K. P.) & McGarr (R. L.). **Large-scale Sulphur-dusting Experiments for Cotton Flea Hopper Control at Port Lavaca, Tex.**—*J. econ. Ent.* **30** no. 1 pp. 130–134. Menasha, Wis., February 1937.

Fields of cotton of an average size of 34·1 acres on 10 farms in southern Texas were dusted with sulphur in 1935 to ascertain the cost and practicability of using this treatment on a large scale for the control of *Psallus seriatus*, Reut. There was no noticeable difference in the toxicity of the two brands of 300-mesh sulphur used, of which one was 99·8 per cent. pure and the other contained a 2·5 per cent. conditioner. Excessive rain during the end of May and beginning of June delayed dusting in all except two experiments and prevented maximum control being obtained. In each experiment, 2–4 effective applications were made. The average amount of sulphur and total cost of treatment per acre were 62·1 lb. and just under 11*s.* Most of the dusting was done between midnight and 7 a.m. In the 10 experimental areas, the average numbers of *P. seriatus* per 100 buds just before dusting and the average numbers of adults and of nymphs after dusting were 59·4, 15·5 and 28·3 on control plots and 58·3, 11·7 and 4·8 on the plots under treatment. The increase in the yield of seed cotton per acre in the treated plots was 167·53 lb. or 34·3 per cent., the net profit from which was a little under £1. In two experiments there was a net loss, the yield in one case being less than in the untreated plot. In the same year, 24 field plots, each 1 acre in extent, were dusted with sulphur, the average number of applications to each being 5·7. The increase in yield per acre of treated plots was only 127·8 lb., the cost of dusting much higher than in the larger experiments and the net profit under 6*s.* per acre.

Roaf (J. R.), Dimick (R. E.) & Mote (D. C.). **The Cotoneaster Webworm, *Cremona cotoneastri* Busck.**—*J. econ. Ent.* **30** no. 1 pp. 134–136, 1 ref. Menasha, Wis., February 1937.

Observations on *Cremona cotoneastri* attacking *Cotoneaster horizontalis* in Oregon were made in 1933 and 1934. It was first observed in 1929, and was described as a new genus and species by Busck [*Proc. ent. Soc. Wash.* **36** pp. 82–85, 1934], who suggested that, like its food-plant, it may be of Asiatic origin. It is now becoming increasingly injurious in various localities in Oregon, and several infestations have been observed at one place in south-western Washington.

Eggs are laid in late June and July, singly or in pairs, on various parts of the food-plant. The larvae, which hatch in late June, July or early August, make small silken tubes extending out of a larger silken case at the junction of the branches. They grow rapidly in spring and early summer, skeletonising the leaves of the food-plant, occasionally with fatal results, and making the plants unsightly with their webs. While feeding, the larva extends its head out of the tube, but moves quickly backward at the least disturbance of the bush. The larvae overwinter in the silken case, occasionally emerging and feeding a little on warm days, and pupate in it in late spring or early

summer, having previously strengthened it. The adults, which emerge about 2 weeks after the pupal case is formed, are active at night and frequently attracted to lights. During the day, they are usually found on the lower surface of the leaves or on the inner leaves. The Chalcid, *Spilochalcis albifrons*, Walsh, was reared on several occasions from pupae of *C. cotoneastri*, but does not appear to affect its numbers greatly.

The larvae are readily controlled by sprays or dusts, if both surfaces of the leaves are thoroughly covered. Treatment is most satisfactory in late summer or early autumn, but effective control may be obtained whenever the larvae are feeding. Sprays composed of nicotine sulphate (1 : 600), or of 3 teaspoonfuls lead arsenate, 1 cup skimmed milk and water to make 1 U.S. qt. were satisfactory. The lead arsenate residue may be washed off by hosing with water a few days after application. A dust composed of 1 part derris (5 per cent. rotenone) and 9 parts hydrated lime also gave good control, though its action was slow.

Thomas (W. A.) & Reed (L. B.). **The Field Cricket as a Pest of Strawberries and its Control.**—*J. econ. Ent.* **30** no. 1 pp. 137–140. Menasha, Wis., February 1937.

Gryllulus (*Gryllus*) *assimilis*, F. (black field cricket), which has caused appreciable loss in North Carolina during the past 10 years by attacking strawberries, is present in destructive numbers wherever they are grown in the eastern coastal States as far north as New York. Damage may be done at any stage, but the most serious is the killing of the runners and young plants in autumn and feeding on the developing buds, blossoms and all stages of the fruit in the spring. The pine needles often put round the plants as a mulch provide protection for the crickets and concentrate them near the plants.

In 3 laboratory tests on control, wheat middlings, cottonseed meal, equal parts of wheat middlings and cottonseed meal, maize meal and a chicken food composed of various grains, lucerne, meat scrap and dried buttermilk (all moistened with 10 per cent. molasses solution) were compared as baits, and derris, white arsenic, Paris green, sodium fluoride, sodium fluosilicate, barium fluosilicate and calcium arsenate as poisons. Bait three days old that had begun to ferment was also compared with fresh bait. There was no outstanding difference in effectiveness between the various bait materials nor between the fresh and stale baits. Of the poisons, sodium fluosilicate was the most toxic, giving 100 per cent. mortality in every bait, closely followed by calcium arsenate, the other fluorine compounds, and white arsenic. Paris green and derris were less effective. The fluorine compounds were much quicker in their action than the arsenicals. On 25th April 1933, baits of barium fluosilicate and calcium arsenate were compared in a field half an acre in extent with a heavy crop, in which harvesting had already begun but hardly any marketable fruit were being found. The baits, which were composed of 1 part poison to 20 parts maize meal by weight with molasses and water to moisten, were sprinkled late in the afternoon, on one side of each row at the approximate rate of 40 lb. per acre. Nine days after treatment, no live crickets or freshly eaten berries were found on either of the treated plots. On the untreated plots, 1–8 live crickets and 13–60 freshly eaten berries were found on 63 ft. of row.

DEARBORN (F. E.). **Homologs of Paris Green. III. Members of the Oleic and Linoleic Acid Series.**—*J. econ. Ent.* **30** no. 1 pp. 140–143, 3 refs. Menasha, Wis., February 1937.

Investigations were carried out to determine whether acids of the oleic and linoleic series could replace acids of the acetic series in the preparation of homologues of Paris green [*cf. R.A.E.*, A **23** 649; **24** 541]. Crotonic, oleic and erucic acids were selected to represent the lower, intermediate and higher members of the oleic series, and linoleic acid alone to represent its group. Definite complex compounds containing various proportions of copper arsenite and copper soap were made from these acids. The methods of analysis are given. The compounds were purified by extracting with carbon tetrachloride or with ether followed by carbon tetrachloride. The arsenic content was slightly below the theoretical value in all cases, and the copper content slightly above in all cases except one. It is nevertheless thought that the combining ratio of copper oxide to arsenious oxide is 4 : 3, the deviation being probably due to difficulty in purifying the compounds. It is inferred that all acids of the oleic and linoleic series of fatty acids form complex compounds of the general formula $3CuAs_2O_4.CuO$ (acid anhydride), similar to Paris green.

WEBBER (R. T.). **Laboratory Propagation of *Compsilura concinnata* Meigen.**—*J. econ. Ent.* **30** no. 1 pp. 144–149, 2 refs. Menasha, Wis., February 1937.

To facilitate the establishment of *Compsilura concinnata*, Mg., in districts of the United States into which it has not yet been successfully introduced, its propagation in the laboratory was begun so that supplies might be available when they could not be obtained in the usual way by collection of parasitised larvae of *Lymantria* (*Porthetria*) *dispar*, L., *Nygmia phaeorrhoea*, Don., or *Stilpnotia salicis*, L. This Tachinid is now known to parasitise upwards of 130 species of Lepidoptera [*cf. R.A.E.*, A **14** 257; **23** 169] and usually has 3–4 generations a year. Some of the progeny of the first and second generations emerge as adults before the winter, while others hibernate as larvae in the pupae of various hosts and emerge as adults in late May or early June. The period from pairing to larviposition occupies 5–6 days, and the larval and pupal stages 8–12 and 12–14 days, respectively. These stages are longer at the end of the season. Adults live well in confinement, frequently surviving for 40 days or more. The reproductive capacity is believed to be about 100 larvae per female.

For pairing, adults were put into cages (8 × 8 × 14 ins.), with wooden frames covered with cotton on all sides except the back, which was provided with a sliding pane of glass. The paired flies were removed in a vial in which they remained until they separated, when the males were returned to the cage and the females put, in batches not exceeding 50, into wooden boxes (4·2 × 6·2 × 9·2 ins.), with sliding glass covers and a circular hole 2 ins. in diameter at one end, closed with a cork stopper, through which food and material to be parasitised were passed. The flies were kept at 60°F. and fed daily on a solution of honey and water (1 : 4) on a sponge. Parasitisation is most effective when only 5–6 females are used in each box. When they become reluctant to larviposit, they should be withdrawn for the remainder of the day and others substituted. When 25 or more

larvae were confined in a cage (14 × 16 × 36 ins.) with several *Compsilura* adults, the number of puparia recovered was very variable and as a rule they were small, and females died long before their supply of young was exhausted.

Lists are given of the numerous moths and butterflies on larvae of which the parasite was reared and of those in which it could overwinter. The propagation experiment was started in July 1932 with 129 paired females, the progeny of which numbered 1,090. Parasitisation during August and September of 5,001 hosts in which overwintering was possible yielded 1,369 Tachinids, only 52 of which overwintered. In 1933, 27 *Compsilura* adults, obtained between 29th April and 5th May by forced emergence, were allowed to pair and reproduce. During the season, 3,317 larvae were parasitised, and from them 1,601 Tachinids were bred, all but 162 emerging before the end of the year. The overwintering material was brought into the laboratory in April 1934 and the 162 parasites emerged between 26th April and 9th May. By 9th June about 2,000 first-generation puparia had been obtained from them. The proportion of overwintering individuals appeared to be influenced by the species of the host and by season much more than by the generation of the parasite or the stage of the host larva when parasitised. During the experiments, no generation produced exclusively overwintering progeny, but in comparable parasitism of *Euchaetias egle*, Dru., and *Hyphantria cunea*, Dru., about 5 times as many overwintered flies were obtained from the latter. The effect of season may be the result of excretory accumulation [B **11** 55]. Adult parasites produced late in the season often perish for lack of hosts.

Small consignments of puparia were sent to Washington State, for liberation against *Stilpnotia salicis* in early June 1933, and, in 1934, 2,034 puparia, obtained by propagation of forced adults, were sent on 23rd and 28th May and 2nd and 6th June and were released under satisfactory conditions. Two consignments, totalling 600 puparia, were sent to Oregon for possible establishment against *Coloradia pandora*, Blake, on 6th and 11th September 1933. None of the consignments could have been obtained on the dates concerned by field-collection.

BARBER (G. W.). **Seasonal Availability of Food Plants of two Species of *Heliothis* in eastern Georgia.**—*J. econ. Ent.* **30** no. 1 pp. 150–158, 1 fig. Menasha, Wis., February 1937.

Studies on the seasonal occurrence of *Heliothis armigera*, Hb. (*obsoleta*, F.) and *H. virescens*, F., in the coastal plain within a radius of 50 miles of Savannah, Georgia, were made from 1930 to 1934, inclusive. Both pass through a complete generation in about 4 weeks in summer and 4–6 weeks in spring and autumn. Individuals of *H. armigera* emerge from hibernation from late March to the end of July and enter it from June to the middle of October. Individuals of *H. virescens*, however, emerge from hibernation from late March to early May and enter it from early September to the beginning of November, so that for 4 months, no individuals of this species are in hibernation to provide a reserve population if the active ones die through lack of food. Probably for this reason, it is more adaptable to wild food-plants than *H. armigera*, but the latter also is polyphagous [*cf. R.A.E.*, A **24** 771]. In this area, *H. armigera* feeds on 7 weeds

and 11 cultivated plants, but only 4 of these, maize, soy bean, flax and tobacco, are commonly attacked. *H. virescens* attacks 14 weeds, but only 2 cultivated plants, flax and tobacco. Notes are given on the part of each food-plant attacked and its seasonal availability and on the habitat of the wild ones, together with the relative importance of the crops and damage. During the period of observation, *H. armigera* usually passed through 1 or 2 generations on *Linaria canadensis* or flax in April and May, 3 on maize in June, July and August and 1 or 2 on *Meibomia purpurea* or soy beans from September to October. *H. virescens* went through 1 or 2 generations on *L. canadensis* or flax in April and May, 1 on *Rhexia alifanus* in June and July and 2 or 3 on *M. purpurea* from July to October. *H. virescens* was quite as abundant as *H. armigera* and more generally distributed than the latter, the food-plants of which usually grow on arable land. At no time during the investigations was there less food available than the current populations of either species required.

KEARNS (C. W.) & FLINT (W. P.). **Contact Insecticidal Properties of various Derivatives of Cyclohexylamine.**—*J. econ. Ent.* **30** no. 1 pp. 158–166, 4 figs., 6 refs. Menasha, Wis., February 1937.

Laboratory tests were made on the toxicity to *Myzus porosus*, Sand., and *Tetranychus telarius*, L., of cyclohexylamine and 41 of its derivatives belonging to 6 classes. The Aphids were brushed from the plants into petri dishes covered with flannel and the mites were sprayed on the plants.

N-alkyl derivatives of cyclohexylamine were tested against *M. porosus* to compare their toxicities. With the exception of N-octyl cyclohexylamine, they were quite non-toxic to *T. telarius*. The N, N-alkyl-acyl derivatives, however, were toxic to both, and in some cases appeared to have greater toxicity to *T. telarius* than was indicated by the tests on the Aphid. N, N-amyl-benzoyl cyclohexylamine and N, N-amyl-acetyl cyclohexylamine proved to have exceptionally high toxicities as contact insecticides.

It is concluded from the experiments on derivatives of cyclohexylamine that the substitution of the second hydrogen atom of ammonia by an alkyl group tended to produce greater toxicity than various acyl, aryl or aralkyl substitutions. Toxicity generally increased with the number of carbon atoms in the alkyl group, at least up to and including eight. This increase might be due to certain physical properties imparted to the molecule by the long chain alkyl group, which makes it less water-soluble and more like oil in its physical properties. The substitution of certain acyl groups for the third and last remaining hydrogen atom of ammonia produced an exceptionally toxic compound, if the other two replaceable hydrogen atoms were substituted by a cyclohexyl group and an alkyl group such as amyl. Benzoyl, acetyl, and formyl groups increased toxicity when substituted on the nitrogen atom of a compound such as N-amyl cyclohexylamine, while N-proprionyl and N-butyryl substitutions decreased it. The high toxicity of N, N-amyl-benzoyl cyclohexylamine and N, N-amyl-acetyl cyclohexylamine show that all three hydrogen atoms of the ammonia radical may be replaced by certain organic nuclei to produce highly toxic compounds. However, phenyl, benzyl

or cyclohexyl groups substituted for the alkyl group and phenyl or alkyl groups substituted for the cyclohexyl group greatly decreased toxicity.

RITCHER (P. O.) & CALFEE (R. K.). **Nicotine in Oil. A Promising Insecticide for Horticultural Purposes.**—*J. econ. Ent.* **30** no. 1 pp. 166–174, 2 figs., 18 refs. Menasha, Wis., February 1937.

The following is the authors' summary of this account of experiments with nicotine in oil as a spray [*R.A.E.*, A **25** 189]: Free nicotine dissolved in highly refined petroleum distillate shows promise as a horticultural spray. When correctly applied, it did not burn even tender plants and gave a high per cent. kill of many insects with piercing, sucking and chewing mouth parts. It is concluded that 1 per cent. free nicotine in oil is suitable for field and greenhouse use with a minimum of discomfort to the operator and has a toxicity equivalent to 0·1 per cent. pyrethrum in oil. It was found possible to dissolve free nicotine in oil by two methods. The first is by adding 100 per cent. free nicotine directly to the oil. The second is by shaking commercial free nicotine products, such as 50 per cent., with the oil base and then separating off the oil-nicotine from the settled water and impurities. Nicotine in oil must be applied to plants in the form of a fine fog to avoid plant injury. Several new applicators have been devised and are described. One of these, a new hand continuous atomizer, appears to have immediate commercial possibilities.

HALLER (M. H.), CASSIL (C. C.) & GOULD (E.). **Variability in Lead Residues on Apples.**—*J. econ. Ent.* **30** no. 1 pp. 174–179, 3 refs. Menasha, Wis., February 1937.

Statistical examination of data obtained in experiments in West Virginia in 1935 showed that there were highly significant differences between the lead residues on apples from adjacent trees of the same variety, to which identical sprays containing lead arsenate had been applied from the same tank by the same person. The differences between the residue on duplicate samples of apples from the same tree, representing sampling and analytical errors, were relatively insignificant.

WATERS (H.). **Methods and Equipment for Laboratory Studies of Insecticides.**—*J. econ. Ent.* **30** no. 1 pp. 179–203, 6 figs., 4 refs. Menasha, Wis., February 1937.

Descriptions are given of methods and equipment for use in the study of insecticides, developed during studies begun at Ohio in July 1935. The uniform conditions necessary for the culture of plants and insects all the year round were obtained in a basement room lighted artificially. A temperature of 25°C. [77°F.] was maintained by a radiator and a fan connected with a thermostat. The fan was placed in a box built into the window (which was covered with board to exclude the light) and the air circulated throughout the room, so that the temperature variation was less than 1°C. [1·8°F.]. Connection with the adjoining laboratory was established by a tube through the wall to keep the air fresh. A humidity control unit kept the relative humidity up to

55–60 per cent. The lighting, the culture table, the kinds of plants best suited to the artificial conditions and the procedure adopted in growing and watering them are described. Insects and plants requiring natural light were kept in a greenhouse in which the temperature was controlled, and the plants were watered by one of two automatic systems, both of which are described. Illustrations and descriptions are given of various types of cage suitable for different insects, and methods of rearing *Epilachna varivestis*, Muls. (*corrupta*, Muls.), *E. borealis*, F., *Lycophotia margaritosa*, Haw., *Laphygma frugiperda*, S. & A., and *Leptinotarsa decemlineata*, Say, are appended.

WATERS (H.) & WITMAN (E.). **Studies on Calcium Arsenate.**—*J. econ. Ent.* **30** no. 1 pp. 204–210, 1 fig., 8 refs. Menasha, Wis., February 1937.

Investigations in 1936, on the relation between the preparation of calcium arsenate and its toxicity to plants, showed that rapid agitation of the lime suspension while the arsenic acid was being sprayed into it produced calcium arsenate with a low water-soluble arsenic content [*cf. R.A.E.*, A **24** 256], which was as safe on bean foliage as autoclaved calcium arsenate [**23** 331], whereas slow agitation produced calcium arsenate with a high water-soluble arsenic content and injurious to bean foliage. Other principles found to hold true on a commercial scale were that the temperature range should be 75–100°C. [167–212°F.], the lime should be allowed to slake for several hours and the acid should then be added over a period of 2 hrs., the arsenic acid should be diluted rather than concentrated, and free from As_2O_3, and the lime fresh, with a minimum of carbonation. Calcium arsenate with a water-soluble arsenic content as low as 0·4 per cent. As_2O_5 was made.

To test rapidly the toxicity of calcium arsenate to foliage, bean plants were raised under controlled indoor conditions [see preceding paper] either singly in 2-inch paraffined flower-pots, in which case they were used undisturbed, or else in a flower-pot saucer containing about 35, in which case they were cut and placed in a bottle of water. They were used during the 7 days after the first pair of leaves had reached full size, and the central shoot was cut back. If the material was applied with an atomiser or with a camel's hair brush, severe injury often occurred with even the safest forms of calcium arsenate. The leaves were, therefore, first damped with water from an atomiser, and the chemical was dusted on from a cloth bag and the leaves wetted again. Results are obtained more rapidly if the more sensitive lower surface is used. Another satisfactory method is to dip the plants slowly into a suspension of the material made up to the concentration necessary to give the desired deposit. The plants were kept wet in a humid chamber to increase risk of injury [*cf.* **24** 544]. Occasionally, injury was of the progressive wilting type, especially if the temperature in the culture room exceeded 25°C. [77°F.], but more usually the injured parts of the leaves were killed within a few hours of being removed from the moist surroundings. The percentage of injury does not change while the material is present in a dry condition. In general, under these conditions, unsafe materials applied to the upper surface, to the lower surface and by the dip method caused 100 per cent. injury when the leaves were kept wet for 6–8 hours, 1–2 hours and less than 1 hour, respectively. Safe materials

on the upper surface caused but little injury when the leaves were kept wet for 3 days, on the lower surface very slight injury after 1 day and only moderate injury after 2 days. By the dip method, only slight injury occurs after 12 hours and moderate injury after 24. On this basis, calcium arsenate made on a commercial scale by rapid agitation and having a water-soluble arsenic content of 1 per cent. As_2O_5 was safe.

Preliminary tests on various species of insects indicated that in some cases there was no difference of toxicity between the safe and unsafe forms of calcium arsenate [*cf.* **21** 613], but other species consumed more of a leaf coated with the safe kinds.

DeLong (D. M.) & Kadow (K. J.). **Sugar Beet Leafhopper, *Eutettix tenellus* Baker, appears in Illinois.**—*J. econ. Ent.* **30** no. 1 p. 210. Menasha, Wis., February 1937.

In October 1936, *Eutettix tenellus*, Bak. (sugar-beet leafhopper), which transmits curly top in the Western United States, but had been recorded only once previously from the Eastern States [*R.A.E.*, A **13** 516], was taken in Illinois on horse-radish [*Cochlearia armoracea*] in association with an outbreak of a disease apparently identical with the curly-top disease of horse-radish described by Severin (*Hilgardia* **3** pp. 595–629, 1929). A few individuals of *Aceratagallia sanguinolenta*, Prov., and *Cicadula divisa*, Uhl., were also taken on the diseased plants.

Pletsch (D. J.). **Improved Device for artificial Feeding of Aphids.**—*J. econ. Ent.* **30** no. 1 pp. 211–212, 1 fig., 4 refs. Menasha, Wis., February 1937.

The improved apparatus here described [*cf. R.A.E.*, A **16** 70, 318; **18** 667] was designed for the artificial feeding of Aphids. A membrane was placed over the lower end of a glass cylinder, which contained the feeding liquid and was rested on a standard soft glass test-tube of the same diameter, the flare at the mouth of which had been widened. Aphids were introduced into the test tube through a hole in the side fitted with a rubber stopper. The lower two-thirds of the test-tube was filled with plaster of Paris which, when moistened, kept up the humidity, and short strips of rough paper were placed vertically in the test tube to help the Aphids to reach the membrane. In such apparatus, the exposed membrane area is not excessive and constitutes the entire upper face of the cage, Aphids may be introduced without losing those already present and may be observed by focusing a dissection binocular on the lower surface of the membrane, and the necessary high humidity is maintained.

Campbell (R. E.) & Stone (M. W.). **Dichloroethyl Ether for Wireworm Control.**—*J. econ. Ent.* **30** no. 1 pp. 212–213, 1 ref. Menasha, Wis., February 1937.

In preliminary experiments in California during the winter of 1935-36, beta-beta-dichloroethyl ether at concentrations of 1, 3, 5 and 7 cc. in 1 U.S. gal. water killed, respectively, 60, 66·6, 100 and 100 per cent. of larvae of *Pheletes* (*Limonius*) *californicus*, Mann., kept in small gauze cages in pots containing 1 cu. ft. soil at a depth of 4 ins., 60,

73·3, 100 and 100 per cent. at 8 ins. and 13·3, 6·6, 33·3 and 30 per cent. at 12 ins. The greater kills near the surface were attributed to the fact that the soil was more nearly saturated.

In the spring, when the wireworms had become active, dichloroethyl ether solution was drilled to a depth of 2–3 ins. into baited rows [*R.A.E.*, A **14** 538] in a field of heavy loam at the rate of 1 U.S. gal. to 15 ft. At 5 cc. per U.S. gal., 96·6 per cent. control was obtained, and at 20 cc., 100 per cent. kill resulted whether the solution was drilled in or poured on to the surface. In a field of sandy loam where there were 0·5–2·5 wireworms per foot in the baited rows, 10 cc. per U.S. gal. applied to the surface at the rate of 6 U.S. gals. per 100 ft. gave 100 per cent. kill, and drilled in at the rate of 1 U.S. gal per 100 ft. gave 68·7 per cent. kill; 5 cc. per U.S. gal. gave 94·7 per cent. kill when drilled in at 8 U.S. gals. per 100 ft. and 52 per cent. when applied to the surface at 6 U.S. gals. There was no kill of untreated and water-treated controls.

Stone (M. W.) & Elmore (J. C.). **Dichloroethyl Ether as a Control for Sod Webworms in Lawns.**—*J. econ. Ent.* **30** no. 1 p. 213. Menasha, Wis., February 1937.

Following severe damage to blue-grass [*Poa*] lawns in south-western California by *Crambus* sp. during 1936, a solution of 5 cc. dichloroethyl ether to 1 U.S. gal. water was applied to 50 sq. yds. of turf with a watering can at the rate of 1 U.S. gal. per sq. yd. After 24 hours, 65 per cent. of the larvae, which had been present at the rate of 25 per sq. ft., were killed. In another plot, almost as heavily infested, only dead larvae were found two days after treating with 1 U.S. gal. per sq. yd. of a solution containing 10 cc. dichloroethyl ether to 1 U.S. gal. water, but some pupae were found apparently unaffected. No injury to the grass was noticed during the month following treatment. Three other insecticides tested (pyrethrum extract and emulsions of carbon bisulphide and of kerosene) were more or less ineffective.

Cutright (C. R.). **High Infestation of *Prionus laticollis* Drury in Ohio.**—*J. econ. Ent.* **30** no. 1 p. 215. Menasha, Wis., February 1937.

In early November 1936, several old apple trees growing on a lawn in Ohio were found to be heavily infested with larvae of *Prionus laticollis*, Dru., one tree having all the roots extending to a distance of 5–6 feet from the trunk and to a depth of 2 feet honeycombed with their tunnels.

Snapp (O. I.) & Thomson, jr. (J. R.). **Flight and Movement of Peach Borer Moths.**—*J. econ. Ent.* **30** no. 1 p. 215. Menasha, Wis., February 1937.

During observations in Georgia on the movements of adults of *Aegeria* (*Conopia*) *exitiosa*, Say, it was observed that, though the females are strong fliers, they tend to remain and pair near the tree from which they emerged and to oviposit on it. The greatest distance that a female was observed to fly in one day from the tree on which it started to oviposit was 357 yards. They have a definite tendency to

fly in circles, and do not appear to be strongly attracted to peach orchards. Within the orchard, they oviposit on grass, twigs, weeds and soil, as well as on the peach trees. The male moths are strong fliers and have been observed to fly against a moderately strong wind over maize and cotton fields to a female more than half a mile away.

MAXWELL (K. E.) & MACLEOD (G. F.). **A Scotch Pine Weevil,** *Hylobius radicis* **Buchanan.**—*J. econ. Ent.* **30** no. 1 pp. 215–216, 1 ref. Menasha, Wis., February 1937.

During 1935 and 1936, damage was caused to mature Scotch and Austrian pines [*Pinus sylvestris* and *P. nigra* var. *austriaca*] on the north shore of Long Island by larvae of *Hylobius radicis*, Buchanan [*cf. R.A.E.*, A **25** 375]. They fed at the base of the trunk, just beneath the soil level, either girdling it or eating deeply into the wood on one side. Some of the larger roots were also attacked. The new growth on injured trees was weak and the needles short ; when injury was more severe, the needles became brown and dropped, and, in extreme cases, the trees were blown down by high winds.

On 8th June 1936, larvae appeared to be from half to three-quarters grown. By 23rd July, some had pupated, either beneath the bark or near the base of the trunk in cells in the soil into which pitch had filtered from the wounds. On 25th July, 2 adults were dug out ; and on 22nd August, 16 larvae, 4 pupae and 26 adults were obtained from 5 trees, most of the adults being on the ground, though some were still beneath the bark.

Of several materials tested for control, none was satisfactory. In comparative tests, the fewest larvae and pupae were recovered from trees of which the bases of the trunks had been left exposed all the winter.

COCKERHAM (K. L.). **The Sweetpotato Weevil and how to control it.**—*Leafl. U.S. Dep. Agric.* no. 121, 6 pp., 4 figs. Washington, D.C., 1937.

In the southern United States, particularly in the States bordering the Gulf of Mexico, *Cylas formicarius*, F., often causes severe damage to the tubers and stems of sweet potato. The eggs are laid in the lower part of the stems or directly in the tubers, and the larval and pupal stages occur in these parts of the plant. The incubation, larval and pupal periods last for about 7, 14–21, and 7–8 days, respectively, and in favourable weather the adults may live for several months. Near the coast there may be 6–8 generations annually. Adults injure the plants by feeding on the leaves, stems and tubers. Cultural methods of control [*cf. R.A.E.*, A **23** 381] include deep planting, and banking the soil high up round the base of the stem during cultivation. Seed tubers may be fumigated with paradichlorobenzene [**25** 183].

PUTMAN (W. L.). **Biological Notes on the Chrysopidae.**—*Canad. J. Res.* (D) **15** no. 2 pp. 29–37, 1 fig., 3 refs. Ottawa, February 1937.

This paper deals with biological data on Chrysopids obtained during a study of the predators attacking *Cydia* (*Grapholitha*) *molesta*, Busck, in peach orchards in Ontario [*cf. R.A.E.*, A **20** 513]. The species concerned are *Chrysopa rufilabris*, Burm., *C. plorabunda*, Fitch,

Meleoma signoretti, Fitch, a species thought to be *C. downesi*, Smith, *C. oculata*, Say, *C. nigricornis*, Burm., and *M. emuncta*, Fitch, but only incidental notes are given on the last four, which are of no importance as natural enemies of *C. molesta*. The immature stages of *C. downesi*, *M. emuncta* and *M. signoretti* are described. The durations of the developmental stages of the three more important species at different temperatures are shown in a table ; at about 70°F., the egg, larval and pupal stages of *C. rufilabris* and *C. plorabunda* lasted about 6, 12 and 14 days, respectively, and the larval stage of *M. signoretti* 12 days.

C. rufilabris overwintered in the prepupal stage in cocoons. These are spun among the leaves, with which they fall, on the twigs and inside the curls of the thin outer bark. The eggs were found from 10th June until September ; they were most numerous about mid-July and became very scarce after early August. All eggs observed up to and including the time of maximum deposition were laid by the adults of the overwintered brood. The scarcity of eggs produced by the next generation is thought to be due not to a reduction in the adult population, which was estimated from bait catches, but to a decline in the fecundity of the females. Aphids are perhaps necessary for the proper development of the ovaries, and *Myzus persicae*, Sulz., which is common in the peach orchards during the greater part of June, migrates to other food-plants before the summer generation appears. A partial third generation may occur, but there is considerable overlapping, and the broods are not distinguishable in the field. Adults bred in the laboratory rarely oviposited, although, when supplied with Aphids, they lived for as long as 45 days.

C. plorabunda hibernated in the adult stage and was found in late autumn and early spring among dead grass and fallen leaves, in strawberry beds and in outbuildings. Apparently the adults did not hibernate in the orchards, because of lack of shelter, and did not migrate into them in numbers until June or July. On warm days they were often active until late November and were found in flight again on 22nd March. Oviposition in cages began at the end of June or in July. It is possible that there are 3 generations a year, but these could not be distinguished. Females of the summer broods caged on twigs infested with Aphids usually oviposited, laying from 18 to 114 eggs and living for as long as 42 days, while those that had overwintered laid more than 56 eggs in 5 weeks.

Meleoma signoretti passed the winter as a prepupa within the cocoon. In the laboratory, a few adults emerged the first week in June. In 1932, the only year in which this species was abundant, the first eggs were found in the orchards on 5th July, the greatest number on 20th July and the last on 24th August. There is one complete generation annually and, at least in some years, a partial second. In 1931, adults were taken in bait traps from 18th August to 8th September, but in 1932, when the species was much more abundant, larvae maturing as early as 7th August did not give rise to adults in that season.

In the orchards, larvae of *C. rufilabris* were seen attacking eggs and larvae of *C. molesta*, nymphs of *Pulvinaria amygdali*, Ckll., *Lecanium* (*Eulecanium*) *corni*, Bch., *Trialeurodes vaporariorum*, Westw., *Erythroneura obliqua*, Say, and all stages of *Paratetranychus pilosus*, C. & F. They could not be satisfactorily reared on *Aphis pomi*, DeG., or woolly species of Aphids. In the insectary, larvae of *C. plorabunda*,

M. signoretti and *C. downesi* fed on Aphids and eggs and larvae of *C. molesta* and the flour moth [*Ephestia kuehniella*, Zell.].

From 1930 to 1935, population studies of Chrysopid eggs were made in 4 selected peach orchards in the Niagara Peninsula. *C. rufilabris* was by far the most prevalent species in every year except 1932. *C. plorabunda* was quite common in 1931 and 1932, and *M. signoretti* in 1932. Eggs of *C. oculata* were most numerous in June and the greatest numbers were found in 1934, a year of unusually heavy Aphid infestation. Those of *C. nigricornis* were observed only once. The numbers of larvae of *C. rufilabris*, *C. plorabunda* and *M. signoretti* were approximately proportionate to the numbers of eggs. Those of *C. oculata* were exceedingly scarce, and it is thought that they probably migrated to the soil or low vegetation. The most important factor limiting the Chrysopid population appeared to be lack of sufficient food. Parasitism of the eggs by *Trichogramma minutum*, Riley, was 7 per cent. in 1931, 5 per cent. in 1932 and 1935, and negligible in 1933 and 1934. An abundance of Chrysopid eggs is probably important as a reservoir in which a stock of *Trichogramma* may be built up to attack the later generations of *Cydia molesta*. The prepupae are parasitised by *Chrysopoctonus rileyi*, Ashm., which was reared from summer cocoons of *C. rufilabris*, *C. plorabunda* and *C. nigricornis*. *Hemiteles tenellus*, Say, was reared from both the summer and winter cocoons of *C. rufilabris* and *C. plorabunda* and was probably hyperparasitic on *C. rileyi*. Another hyperparasite, *Perilampus chrysopae*, Cwfd., was reared once. *C. rufilabris*, *C. plorabunda* and *M. signoretti* were abundant enough to be of considerable importance in the control of *C. molesta* in 1930 and 1931, but from 1932 to 1935 they were apparently of minor value. The period of their maximum abundance coincides closely with the time that the second-brood eggs of the moth are laid.

Grasshopper Menace serious for 1937.—*Press Cop. Dom. Dep. Agric.* no. 71; 1 p. Ottawa, 10th March 1937.

Surveys of the distribution and numbers of grasshopper eggs in the soil indicate that about 53,000,000 acres of the Prairie Provinces of Canada will probably be infested by grasshoppers in 1937, this area representing an increase of about 9,500,000 acres over that threatened in 1936. It is thought that organised control campaigns will not be necessary in Manitoba, but that in Saskatchewan and Alberta the outbreak will probably assume serious proportions.

Alvarado (J. A.). **Plaga de gusanos del pino en San Juan del Obispo.** [An Outbreak of Larvae on Pines in San Juan del Obispo, Guatemala.]—*Rev. agríc.* **14** no. 5 pp. 271–274, 1 fig. Guatemala, 1936.

The insect defoliating pines in Guatemala [*R.A.E.*, A **25** 294] has been found to be a sawfly; descriptions are given of the adult, egg, larva and cocoon.

Audant (A.) & Occénad (A.). **The Mexican Cotton Boll Weevil, *Anthonomus grandis* Boheman, in Haiti.**—*J. Agric. Univ. Puerto Rico* **21** no. 1 pp. 69–76, 1 map. Río Piedras, P.R., January 1937.

Anthonomus grandis, Boh., which was formerly confined to the south-eastern United States, the cotton-growing regions of the Pacific and

Gulf coasts of Mexico, and a few localities in Central America, was accidentally introduced into Haiti about 1932 and had become a major pest of perennial cotton by 1935. Before its introduction, the annual export of cotton from Jacmal over a period of 9 years averaged about 1,400,000 lb., but since 1932 the amount has fallen steadily and was only about 256,000 lb. in 1935–36. A similar decrease in production has resulted in other infested districts. Owing to strict quarantine regulations, infestation has not yet spread to all the cotton-growing districts, though it is impossible to eradicate the weevil or prevent its spreading in the direction of the prevailing winds. Perennial cotton produces fresh green leaves, on which the adult weevils feed, for almost the entire year, and so completely shades the ground between the rows that the immature stages in fallen bolls and squares are not killed by the heat of the sun. The production of squares is largely confined to 2 months, but sufficient numbers are produced outside this period to allow the weevil a much longer phase of reproduction than do strains of American upland cotton specially selected for a short season. The Haitian strains of perennial cotton are, however, very resistant to the pink bollworm [*Platyedra gossypiella*, Saund.], infestation by which does not normally exceed 1–2 per cent., even at the very end of the picking season. It has been suggested that they should be replaced by an annual short season type, but it is possible that *Anthonomus* may eliminate the strains susceptible to its attack, just as *Platyedra* has eliminated imported varieties [*R.A.E.*, A **19** 347].

Wolcott (G. N.). **What the Giant Surinam Toad, *Bufo marinus* L., is eating now in Puerto Rico.**—*J. Agric. Univ. Puerto Rico* **21** no. 1 pp. 79–84, 3 refs. Río Piedras, P.R., January 1937.

In a series of analyses, faecal pellets of *Bufo marinus* in Porto Rico were found to contain the remains of very large numbers of adults of *Chalepides* (*Parachalepus*) *barbatus*, F., and *Lachnosterna portoricensis*, Smyth [*cf. R.A.E.*, A **21** 235, **22** 155] and a few examples of various other insects, including the predacious Elaterid, *Pyrophorus luminosus*, Ill. The latter is much less common at Río Piedras than it was before the introduction of *B. marinus*, but it is as abundant as formerly in the mountains, where the toad is noticeably scarce. The author concludes that no decided change in the food-habits of the toad has occurred in recent years owing to the increasing scarcity of *Lachnosterna*, and that the even greater scarcity of some of the other insects and animals previously eaten has produced a trend towards more exclusive selection of these beetles for its food. The toad itself is now much less abundant than it was a few years ago.

Charles (V. K.). **A Fungus on Lace Bugs.**—*Mycologia* **29** no. 2 pp. 216–221, 2 figs., 1 ref. Lancaster, Pa, 1937.

Hirsutella verticilliodes, sp. n., is described from *Leptopharsa heveae*, Drake & Poor [*cf. R.A.E.*, A **23** 512] on *Hevea brasiliensis* in Brazil. Dr. C. H. T. Townsend, who collected the bugs, stated that a considerable percentage of the nymphs had been killed by the fungus. Later, Dr. J. R. Weir reported that it had practically eliminated the Tingid over wide areas in some of the localities in which rubber had been planted.

Piovano (A. P.). **Zwei filtrierbaren Virus übertragende Insekten in Argentinien.** [Two Insects in Argentina transmitting filtrable Virus.]—*NachrBl. SchädlBekämpf.* **12** no. 1 pp. 35–40, 6 figs. Leverkusen, March 1937. (With Summaries in German, French, Spanish.)

The author discusses the occurrence in Argentina of virus diseases in potato, tomato and *Capsicum*. All these plants are infested by *Myzus persicae*, Sulz., which is presumably the vector. In the author's experiments, however, a virus disease of tomato was transmitted by the Jassid, *Agalliana* (*Agallia*) *sticticollis*, Stål.

Schedl (K. E.). **Die Bekämpfung der Fichtenborkenkäfer und Erfahrungen aus der Sturmkatastrophe im Regierungsbezirk Wiesbaden.** [Measures against the Spruce Bark Beetle and Experiences from the Storm Wreckage in the District of Wiesbaden.]—*Mitt. Forstwirtsch. Forstwiss.* 1936 no. 5 pp. 521–557, 17 figs. Hanover, 1936. [Recd. April 1937]. **Erfahrungen aus den Borkenkäfer-Vorbeugungsmassnahmen im Regierungsbezirk Wiesbaden 1936.** [Experiences from the preventative Measures taken in 1936 against Bark Beetles in the District of Wiesbaden.]—*Dtsch. Forstwirt* **19** no. 3 pp. 17–19. Berlin, 8th January 1937.

The information given in the second paper is included in the first, which is a very detailed account of investigations made and measures taken in view of severe and widespread injury to spruce forests in Wiesbaden by a hurricane on 18th and 19th April 1936, which caused over 18 million cubic feet of solid timber to be thrown to the ground. Stands at altitudes between 1,000 and 1,600 ft. were chiefly affected. To prevent a mass-increase of bark-beetles, orders were given for felling and barking and for burning of branches, bark and tops up to 1st August. An inspection on 3rd and 4th June showed that the flight of the spruce bark-beetles, *Ips typographus*, L., and *I.* (*Pityogenes*) *chalcographus*, L., was still in progress. An account is given of the prevalence of infestation in stands of various ages and in different parts of the tree trunk, and the methods used for ascertaining it, and of the results of examination of trap trunks specially felled in view of the danger to trees that were apparently able to recover but afforded opportunities for breeding because of loosening and exposure of the roots.

Examinations of the stages found on 1st July and observations at the end of September showed that there was only one generation in 1936, but that 18 per cent. of the females had a second brood. The percentage of infestation was very high; on 1st July, 2·8 per cent. of 21,007 trunks were infested by *I. typographus* alone, 17·9 per cent. by *I. chalcographus* alone, and 3·5 per cent. by both. The percentage of infestation by *I. chalcographus* was the higher in trees of all age groups. With both beetles, the percentage rose with increased age of the stand, but the percentages for the different tree groups indicated that *I. chalcographus* was less exacting in its requirements than *I. typographus* and was therefore more likely to cause primary injury. Both species preferred material with thin bark, but adapted themselves readily to bark of different thicknesses. The percentage of infestation

varied considerably in the various forestry divisions ; this is ascribed to differences in the intensity of their forestry exploitation, for the minimum residual beetle population depends on the breeding facilities available. Infestation by *I. typographus* was about the same at about breast height, in the middle portion of the trunk and in the middle of the crown. *I. chalcographus* seemed to prefer slightly the middle of the trunk.

Figures are given showing the division of storm-thrown trees in the various age groups, according to the number of trunks, solid timber mass and trunk surface, thus supplying data regarding the breeding opportunities available. The population density per acre increased with increasing age of the stands in the various age groups. The figures tabulated are believed to supply the first reliable bases for population densities preceding bark-beetle outbreaks. The sexes were in equal proportion in the case of young adults of *I. typographus* ; among the old beetles there were 51 females to 20 males. The coefficient of increase was 13·7 ; it would probably be higher in the second year after a storm.

Griep (E.). *Trogoxylon impressum* **Com., ein wenig bekannter Vorratsschädling (Col. Lyct.).**—*Märk. Tierw.* **2** no. 3 pp. 223–225. Berlin, 15th January 1937.

In November 1932, the author received from Potsdam reeds (*Arundo donax*), apparently imported from the south of France, that were attacked by *Lyctus* (*Trogoxylon*) *impressus*, Com. It is uncertain whether the reeds were already infested when introduced. The beetle has been recorded from Alsace, especially in the wood of fig trees.

[Silant'ev (I. M.), Kozhanchikov (I. V.) & Mikhaĭlova (T.).] **Силантьев (И. М.), Кожанчиков (И. В.) и Михайлова (Т.). The Influence of Soaking of Hemp Stems on the Larvae of** *Pyrausta nubilalis* **Hbn. and the physiological Basis of this Measure.** [*In Russian.*]—*Bull. Plant Prot.* (1) no 14, 50 pp., 3 figs., 7 graphs, 33 refs. Leningrad, 1936. (With Summaries in English pp. 31 & 49.) Price 1 *rub.* 75 *kop.*

In view of contradictory results obtained in different parts of European Russia on the effect of retting hemp on larvae of *Pyrausta nubilalis*, Hb., special laboratory observations, the results of which are recorded in two papers, were carried out in 1932–34.

The first paper (pp. 7–32), by Silant'ev, includes notes on the methods of retting hemp, and information from the literature on the effect of submergence on the larvae of *P. nubilalis* [*R.A.E.*, A **15** 537]. An account is given of original experiments showing that the rate of mortality of the larvae in the stems of hemp is directly dependent on the temperature of the water. When diapausing or active larvae either free or in the stems were placed for periods ranging from 2 to 45 days in water of which the average day temperature varied from 5·5 to 36°C. [41·9–96·8°F.], mortality invariably increased as the temperature of the water rose. All the larvae survived for 20 days or more at temperatures below 8·5°C. [47·3°F.], whereas all died in 14 or 15 days at 17°C. [62·6°F.]. At a given temperature the diapausing larvae survived considerably longer than the active ones. The effect of retting in cold water in the field depended on the season. Complete

mortality of the larvae in the stems was obtained in 10–16 days if the hemp was retted at about the end of August or May, at a mean water temperature of 12–18°C. [53·6–64·4°F.]. On the other hand, retting in September—October at low temperatures (8–11°C. [46·4–51·8°F.]) killed not more than 15 per cent. of the larvae even if it lasted for 40 days or more. During warm retting in factories, all larvae were killed in 4 days (before the process of retting was finished) at a water temperature of 31°C. [87·8°F.], or in 43½ hours at 36·5°C. [97·7°F.]. It is concluded that not less than 50 per cent. of the larvae in the stems will survive if the hemp is retted in water at temperatures below 10°C. [50°F.], whereas at a mean temperature of 15°C. [59°F.], the stems should be free from infestation and may, therefore, be stored with safety.

In the course of retting, some of the larvae rise to the surface of the water and try to escape. In laboratory experiments, the percentage that succeeded in making their way out of the water varied from 4·9 to 10·1. In practice only a few would be able to escape, since the retting pits are usually about 7 ft. deep and the larvae from the middle and lower layers of the hemp would not be able to reach the surface of the water sufficiently quickly. The destruction of weeds and other débris for about 20 yards round the retting pit is recommended, thus destroying all the larvae that may have migrated there from the water.

The subsequent development of larvae that survived cold retting for 16 days in the autumn was not affected to any appreciable extent. Females from larvae that had survived a spring retting of 3–8 days laid eggs, but their fecundity decreased in proportion as the retting lasted longer. Parasites of the larvae were killed by the retting before or with their hosts.

The second paper (pp. 33–49), by Kozhanchikov & Mikhaĭlova, deals with the physiological processes that take place in the larvae during submergence and that apparently account for their resistance to it. Work by various investigators on the capacity of terrestrial insects to survive more or less lengthy immersion in water and on the part played in it by respiration is reviewed, and the technique used in experiments on the submergence of diapausing larvae of *P. nubilalis* is described. The larvae were able to live in water by means of both oxygen respiration and anaerobic metabolism. The duration of the larval life in water at all temperatures was twice as long under aerobic as under anaerobic conditions, this indicating that oxygen dissolved in the water is utilised by the submerged larvae. The intensity of oxygen consumption by the larvae increased after submergence, but the quantities of oxygen consumed varied with the temperature of the water, a rise in the latter stimulating consumption and thus accelerating death. At 25°C. [77°F.], the larvae consumed 2–3 times as much oxygen as at 15°C. [59°F.].

Larvae diapausing in the autumn were considerably more resistant to submergence than those doing so in the spring, as owing to their accumulation of fat-body, which permits anaerobiosis, they consumed less oxygen than the light-weight spring larvae that had no such reserves and therefore required more oxygen. Diapausing larvae submerged in the autumn at a temperature of 15°C. lived for up to 20 days, whereas those submerged in the spring survived only 8 days. Larvae that had completed the diapause in spring lived for only a few hours when submerged.

The Effect of Insecticides upon Plants. (Materials pertaining to the Study of the Burn Phenomenon.) [*In Russian.*]—*Bull. Plant Prot.* (3) no. 4, 107 pp., 15 graphs, 10 figs., 96 refs. Leningrad, 1935. (With Summaries in English.) Price 4 *rub.* 50 *kop.* [Recd. 1937.]

Investigations on the physiology of injured plants [*cf. R.A.E.*, A **21** 392] were continued in Russia in 1932 and 1933 with special reference to the damage caused by insecticides. The results are presented in six papers.

In the first, A Study on Burns of Fruit Trees resulting from the Application of Mineral Oil Emulsion Sprays (pp. 7–18), A. A. Bogdarina discusses the relation between the temperature and humidity of the air and the scorching of plants by mineral oil emulsions. Details are given of the microscopic study of the penetration, disposition and effect of oil in the tissues of the leaves of apples, oranges and mandarins. It is concluded from the results that a highly toxic substance, such as naphthene acid, produces a rapid coagulation of the plasm, followed later by the destruction of the green plastids. Less toxic preparations, or low concentrations of the highly toxic ones, on the contrary, first destroy the latter, whereas the plasm is coagulated only under certain conditions of humidity and temperature. Beyond the actual spot of the burn, the cell-plasm runs and the plastids concentrate at the cell-wall and become small. The spongy parenchyma of the leaves is reached and injured first, as the oil penetrates through the stomata [*cf.* **20** 58] into the intercellular space. This indicates that oranges, in which the spongy parenchyma is porous, will be more severely scorched than mandarins, in which it is compact. Oil emulsions cause most injury if applied during the hottest part of the day, when the percentage of open stomata is largest. Experiments with apple and mandarin showed that a rise of temperature increases the injurious effect of oil-soap emulsions, especially under conditions of reduced humidity. This is probably because increased transpiration of the leaves, resultant from low humidity, facilitates the access of the oil into the tissues, while high temperature accelerates the rapidity of its penetration. Soap solutions, on the contrary, were more harmful when high humidity of the air prevented them from drying quickly, so that the soap had longer to penetrate into the leaf through the epidermis. Mineral oil emulsions will therefore cause more injury in dry districts and soap solutions in damp ones.

The second and third papers (pp. 19–28 and 29–38), both by P. I. Kiyashko, are entitled The Effect of Dusting with Arsenic and Fluorine Preparations upon the physiological Functions and Yield of Plants, and The combined Effect of mechanical Lesions and Dusting upon the physiological Functions and Yield of Plants, and deal with observations conducted on potted plants in Leningrad in 1931 and 1933, respectively. In the first series of experiments, oats and flax were grown under a glass roof to protect them from rain and thus prevent scorching by the dusts. In the course of July, the plants were dusted with sodium fluosilicate or calcium arsenate at the rate of 18 lb. per acre, up to three applications being made on the oats and only one on the flax. Both insecticides, especially if applied once only, stimulated the development of the green parts of oats and the quantity produced, though calcium arsenate caused a temporary initial retardation of growth. The quality of the grain was improved,

but not its yield ; the improvement in quality was most marked after two applications of calcium arsenate, but this decreased the yield by 6 per cent. In the case of flax, both sodium fluosilicate and calcium arsenate retarded the development of flowers and fruit by a few days. Calcium arsenate increased the yield of the stems by 12 per cent., whereas sodium fluosilicate decreased it by 13 per cent.

The experiments of 1933 were made with soy beans and flax. In July, some of the plants were dusted with sodium fluosilicate at the rate of 18 lb. per acre, some were artificially injured on 2½ per cent. of the surface of all developed leaves by means of a brush made of fine wire, and some were thus injured and then dusted. In the case of soy beans, all three treatments reduced the energy of photosynthesis in the first 4 days and decreased the quantity of carbohydrates in the leaves, owing to more intense respiration. From the fifth day onward, however, the accumulation of carbohydrates increased and surpassed that in the control plants. Dusting the plants retarded their maturation by 20 days, dusting combined with mechanical injury retarded it by 10 days, and injury alone accelerated it by 10 days. The average weight of the seed and of the green parts of all the treated plants increased as a result of the accumulation of carbohydrates. It is pointed out, however, that these results were obtained under conditions in which risk of scorching was eliminated. In the case of flax, none of the three treatments affected the height of the plants or the dates of flowering and fruiting, but the weight of the stems was affected by dusting, especially in the case of the injured plants, the amount of the dry matter in them being reduced by up to 21 per cent.

In the fourth paper, An Investigation of the Conditions favouring the occurrence of Burns on Apricot from the Application of Dust in Orchards of the Isfarin Region of Northern Tadjikistan (pp. 39–52), by P. I. Kiyashko, an account is given of field experiments carried out in the Ferghana valley in 1933, chiefly in April, to study the effect of calcium arsenate on apricot trees, since it is usually applied in Central Asia against the weevil, *Rhynchites auratus ferganensis*, Nevsk., on apricots and has in the past caused severe injury to the foliage [*cf.* **25** 150, 151]. Dusting was carried out 1–3 times at the rate of 10·8 or 18 lb. per acre, whereas sprays were applied once only at the rate of 2·8 or 4·4 gals. to a tree, 3 and 5 per cent. suspensions being used. The scorching of the leaves and fruits and the shedding of the foliage that followed applications of the insecticide are discussed in detail. The cause of the injury was the high content of water-soluble arsenic (2·41 per cent.) in the calcium arsenate used. On the dusted trees the scorched areas were concentrated round injuries caused by *Coleophora* sp. and *Cosmia subtilis*, Stgr., and on the sprayed ones they also occurred along the edges of the leaves ; spring treatments should, therefore, be carried out as early as possible when the foliage is only slightly injured by pests. Spraying caused more injury than dusting, and the injury was greatest on trees weakened by pests or by lack of moisture when the soil was very dry. Repeated applications of dust increased scorching and the shedding of foliage. Examination of dusted trees after rain showed that a considerable quantity of the insecticide still remains on the leaves ; a smaller quantity should therefore be used if a supplementary treatment is applied. Some trees showed the effect of dusts or sprays in the year after treatment ; the leaves were brittle and somewhat wrinkled, flowering was less profuse and the flowers were smaller and brightly coloured. The

scorching caused by calcium arsenate dust mixed with slaked lime (4 : 1 or 2 : 1) was slight or severe according to whether the lime was or was not freshly slaked.

In the course of laboratory investigations with arsenicals, sodium fluoride and various fluosilicates described in the fifth paper, The Susceptibility of the Foliage of various cultivated Plants to Burns (pp. 55–84), by Z. M. Eidel'man and E. A. Bankul, it was found that the stomata do not play any appreciable part in facilitating the penetration of these insecticides into sprayed leaves. In some plants, different concentrations of sodium arsenite or sodium fluoride rapidly penetrated through both the upper and the lower epidermis of the leaves, whereas in others the lower surface was more permeable. Sodium arsenite spread readily in the tissues, whereas sodium fluoride and sodium fluosilicate diffused slowly and caused only localised scorching. Waxy leaves, such as those of cabbage, are not penetrated by the insecticides, whereas plants with hairy leaves (such as soy beans, cucumbers or sunflowers) are very susceptible to injury, as the hairs retain the moisture and thus increase the risk of scorching. In experiments on apple, the scorching action of 0·25 per cent. sprays of sodium fluosilicate was not increased appreciably by a rise in temperature from 25 to 35°C. [77–95°F.], when the humidity was 65–70 per cent., whereas the toxicity of aluminium fluosilicate and sodium arsenite increased considerably. At lower humidity (50–55 per cent.), the injury was reduced and a rise in temperature had practically no effect on scorching by any of the preparations tested. At 90 per cent humidity and 25–35°C., there was practically no difference in the degree of scorching caused by fluosilicates of potassium, sodium or aluminium. In dusting experiments at 65 per cent. humidity, scorching by sodium fluosilicate was greatly reduced by a drop in temperature from 35 to 22°C. [95–71·6°F.], whereas at 90 per cent. humidity considerable scorching occurred even at 22°C. Calcium arsenate dust caused comparatively little damage to apple at any conditions of temperature and humidity. In the case of all salts tested, 0·05 per cent. sprays at 20–26°C. [68–78·8°F.] and a humidity of 65 per cent. caused considerable scorching on the second day after the application, whereas concentrations of 0·006 and 0·003 per cent. produced only slight injury. Dusts that did not scorch vegetables and field crops, even under conditions of high humidity and temperature, were calcium fluoride and fluosilicates of barium and potassium; sodium fluosilicate caused moderate scorching, and calcium fluosilicate and sodium fluoride caused severe injury. Freshly inflicted mechanical injury to the plants increased their susceptibility to scorching.

In the final paper, The Study of the Phenomena of Penetration of Poisons into Plant Tissue in Connection with the Effect of the physico-chemical Properties of Insecticides (pp. 85–106), the same two authors and G. A. Katanskaya deal with experiments in spraying leaves of various plants, chiefly apple, to determine the permeability of the plasm by fluosilicates, sodium arsenite, calcium arsenate and Paris green. The plasm of apple proved to be the most permeable and the most easily injured, being followed in descending order of susceptibility by those of beet, soy beans, cucumbers and cabbage. The degree of the penetration of the insecticide into the plasm varied greatly with the concentration of the spray and the temperature. At higher concentrations (0·1–0·006 per cent.) and at higher temperatures (30 or 40°C. [86 or 104°F.]), fluosilicates of calcium and aluminium

proved to be the most toxic ; at a concentration of 0·003 per cent., sodium fluosilicate was the most injurious. At a drop in temperature from 40 to 30 or 20°C., the toxicity of fluosilicates of barium, aluminium and calcium decreased more than that of sodium fluosilicate. The toxicity of sodium arsenite and calcium arsenate was greatly reduced by a decrease in temperature or a weakening of the strength of the solution ; the latter factor also decreased the effect of sodium fluoride. Paris green, at a 0·1 per cent. concentration, was less toxic than sodium arsenite at 40°C. ; but, unlike the latter, its toxicity changed comparatively little at lower temperatures (30 or 20°C.). Fluosilicates of barium and potassium were the least toxic under all conditions of temperature and at all concentrations.

Studies on the Mechanism of Action of Insecticides. [*In Russian.*]—*Bull. Plant Prot.* (3) no. 7, 100 pp., 17 graphs, 4 pls., 8 figs., 78 refs. Leningrad, 1936. (With Summaries in English.) Price 3 *rub.*

With the view to determining the reasons for differences in the resistance of various species of insects to poisons, investigations were carried out in 1933 in Leningrad on the solubility of different insecticides in the intestinal tract and the degree of their penetration into the haemolymph. The experiments are described in a series of six papers, of which the last two, by M. V. Pilat, are substantially translations of papers that have already appeared in English [*R.A.E.*, A **23** 499, 743].

In the first paper, pH of the Insect's Intestines and Blood and its Modification at poisoning with Arsenic and Fluorine Compounds (pp. 9–24), E. A. Skryabina deals with investigations in which the pH of the digestive tract and haemolymph of a number of insects, chiefly Lepidopterous larvae and Acridids, was determined. The species studied could be divided into two groups. One comprised the Acridids and Coleoptera, all of which showed a slightly acid reaction in the gut (pH 6·48–6·85) and the Acridids also a slightly alkaline reaction in the haemolymph (pH 7·29–7·39), and the other group consisted of the Lepidopterous larvae, which had a highly alkaline reaction in the gut (pH 9·20–9·80) and a slightly acid reaction in the haemolymph (pH 6·56–6·88). It is suggested that the same poison may affect these two groups of insects differently, since its physico-chemical structure may be modified by pH. All the experimental insects showed a cyclic variation in the pH of the intestinal contents during digestion, an initial acid reaction changing to the alkaline conditions characteristic of the digestive secretions. The changes in the pH of the gut after poisoning were studied in larvae of *Locusta migratoria*, L., *Pieris brassicae*, L., and *Euxoa segetum*, Schiff., fed on leaves dusted with sodium arsenite, Paris green or sodium fluosilicate. All the poisons caused an increase of the acid reaction ; the arsenicals also caused a reduction in the secretion of digestive juices, but the sodium fluosilicate did not.

The second paper, Poison Penetration through the Intestine Wall of Insects (pp. 25–39), by A. K. Voskresenskaya, contains a detailed account of observations on the absorption of arsenic by the nymphs of *L. migratoria* and the larvae of *P. brassicae* and *E. segetum*, for which purpose individual insects were dissected at periods varying from 6 hours to 7 days after they had consumed food poisoned with sodium

arsenite or Paris green, containing 84·36 and 53·8 per cent. As_2O_3, respectively. A quantitative micro-analysis was then made of the arsenic in the insect's body from which the gut had been removed, in the gut itself and in the excreta collected up to the time of dissection. Special observations on the velocity with which food passed through the digestive tract of unpoisoned insects, which were carried out with the three species used in the poison tests and with larvae of *Nygmia phaeorrhoea*, Don. (*Euproctis chrysorrhoea*, auct.), showed that an increased alkaline reaction in the gut is accompanied by a prolongation of the time that the food remains in it. Thus, the most rapid movement of food occurred in *L. migratoria*, being followed in descending order of velocity by *P. brassicae*, *N. phaeorrhoea* and *E. segetum*, the pH of the gut being 6·88, 9·43, 9·56 and 9·70, respectively. Poisoning with the arsenicals altered the velocity with which food passed through the intestinal tract, the movement being greatly retarded in the case of *L. migratoria*, accelerated in *P. brassicae*, and retarded for 12 hours and then accelerated (with rapid ejection from the hind-gut) in *E. segetum*. In the case of sodium arsenite, the absorption of poison was almost equal in *L. migratoria* and *P. brassicae*, the maximum amount of arsenic that had penetrated through the wall of the intestinal tract 36 hours after poisoning being 35 and 38 per cent., respectively, of the total amount ingested. In the larvae of *E. segetum* it only amounted to 20 per cent., remaining unaltered for 5 days. Within the range of dosages used, the quantity of arsenic absorbed by *E. segetum* was independent of the dose and averaged 0·004 mg. per gm. live weight. These experiments indicated that *E. segetum* is more resistant to sodium arsenite than *P. brassicae* or *L. migratoria*. Paris green appeared to be more toxic than sodium arsenite, since in the case of *L. migratoria* 44 per cent. of the total dose of arsenic ingested penetrated the intestinal walls of the nymphs in 24 hours after poisoning, and in the case of *E. segetum* 26 per cent. was absorbed in 72 hours. The pH of the intestinal tract was not the main factor governing the penetration of arsenic.

In the third paper, Solubility of some Salts of Stomach Insecticides in Solutions with different pH (pp. 40–54), I. N. Lavrov and V. I. Paramonov describe experiments with saturated solutions of sodium fluosilicate, sodium fluoride, sodium arsenite, calcium arsenite, calcium arsenate and Paris green to investigate the relation between the pH of the solution (which was altered by the addition of hydrochloric acid or sodium hydroxide) and the solubility of the salts. In the solutions of sodium fluosilicate, the concentration of sodium fluoride (NaF) greatly increased as the pH increased to 7·5, but it was approximately constant at a higher pH. The fluosilicate anion (SiF_6'') was not present in solutions at pH above 7.5. When sodium fluoride, sodium fluosilicate and orthosilicic acid ($Si(OH)_4$) were present in the solution simultaneously, the pH of the solution did not change with the addition of alkali. The solubility of sodium fluoride depended but slightly on the pH. Calcium arsenates became more soluble as the pH decreased, this increased solubility being related to a chemical change from the basic to the acid salt. In solutions of sodium arsenite, the content of the ion of arsenious acid became lower as the pH increased. The solubility of calcium arsenite was least at about pH 10, but increased with the addition of acid or alkali, being greatest in acid solutions. The minimum solubility of Paris green occurred at about pH 7.

The fourth paper, On the comparative Resistance of some Species of Insects to the Arsenic and Fluorine Insecticides (pp. 55–77), by B. A. Dodonov, is an account of experiments with the larvae of *L. migratoria, Malacosoma neustria*, L., *Lymantria* (*Porthetria*) *dispar*, L., *N. phaeorrhoea, P. brassicae* and *E. segetum*, which were fed by a modified sandwich method [*cf.* **19** 699] on leaves dusted with sodium arsenite, sodium fluosilicate or Paris green. Toxicity was measured in terms of the minimum dose required to kill all the insects in 5 days. The Lepidopterous larvae, which have an alkaline reaction in the gut, were on an average less susceptible than *L. migratoria*, which alone has a slightly acid reaction. In the case of sodium arsenite and Paris green, however, *P. brassicae* and *M. neustria* showed a resistance equal to that of *L. migratoria*. The solubility of each insecticide was measured at the same hydrogen-ion concentrations as were observed in the different insects ; there was no direct relation between these solubilities and the corresponding toxicities. It is suggested, however, that the chemical constitution of a toxic salt may be modified in the intestine. The toxicity of Paris green (53·80 per cent. As_2O_3) was equal to, or in the case of *E. segetum* and *N. phaeorrhoea* even higher than, that of sodium arsenite (84·36 per cent. As_2O_3), and thus was not proportionate to the arsenic content. This corresponds with the findings recorded in the second paper of this series. The extent of feeding of the larvae on the poisoned leaves apparently depended on the capacity of the poison to produce a local irritating action in the gut, which was shown by a retardation and cessation of feeding. Thus, sodium fluosilicate was eaten less than Paris green but more than sodium arsenite. Moreover, as a rule, leaves treated with sodium arsenite were eaten less readily when the dosage of the poison was increased, but this was not the case with Paris green or sodium fluosilicate. Species that were more susceptible to the local effect of the poison tended to be more resistant to its toxic action [*cf.* **25** 155].

DAVIDSON (J.). **Climate in Relation to Insect Ecology in Australia. 3. Bioclimatic Zones in Australia.**—*Trans. roy. Soc. S. Aust.* **60** pp. 88–92, 2 maps, 10 refs. Adelaide, December 1936.

With this paper, which is one of a series [*cf. R.A.E.*, A **24** 196], is included a map of Australia showing the months and approximate areas in which the precipitation-evaporation ratio, P/E, is 0·5 or more. In a separate coloured chart, areas are defined showing the number of months in the year with a P/E of 0·5 or more. In some places, demarcation is complicated, because such months are not consecutive. The distribution over Australia of mean annual temperatures at intervals of 5°F. is also shown, as, although they have little significance from the point of view of insect ecology, they are adequate in this instance for defining the broad temperature zones, since moisture is the dominating factor.

FROGGATT (J. L.). **Coconut Pests.**—*New Guinea agric. Gaz.* **2** no. 3 pp. 18–21. Rabaul, December 1936.

The Dynastids, *Xylotrupes gideon*, L., *Scapanes grossepunctatus*, Sternbg., and *Trichogomphus semmelinki*, Rits., of which the first two are generally distributed throughout the Territory of New Guinea and the last is apparently confined to the Solomon Islands group,

are not major pests of the coconut palm, but they feed on the soft tissue of the trunk at the base of the head, making holes which often lead to infestation by palm weevils. The eggs, which are deposited in the soil, hatch in 20–29 days. The larval and pupal stages are also passed in the soil, the larvae obtaining nourishment from the humus. The period from oviposition to adult emergence occupies 3–4 months. Characters distinguishing the three species in both sexes are given. The adults are found most frequently on *Poinciana regia* and *Cassia multijuga*, which can be used as trap trees if they are collected from them every day. Decaying vegetable matter should not be allowed to accumulate. One or more species of small Dynastids often kill young palms by eating into the developing bud during the first 18 months of growth.

Eggs of the weevils, *Rhynchophorus papuanus*, Kirsch, and *R. schach*, Ol., are laid in freshly made openings in the trunk, and the larvae tunnel into it and into the head, killing the palm if they reach the bud. If any openings through which they are likely to enter are cleaned and tarred, infestation will be prevented. When the larvae have developed, they can be located by the sound of their feeding if the ear is placed close to the trunk ; the infested portion can then be cut out and the hole tarred. Both species breed freely on the sago palm [*Metroxylon sagu*], of which all old stumps and heads should be carefully destroyed. A smaller weevil, *Sparganobasis subcruciata*, Mshl., which bores into the bole, is widely distributed in the Territory, but does not appear to be nearly so injurious as *Rhynchophorus*. *Tirathaba rufivena*, Wlk. [*R.A.E.*, A **21** 207] occurs throughout the Territory, and an unidentified Tineid has been bred from larvae collected inside unopened spathes. These larvae, which were not observed to do any material damage, apparently hatched from eggs laid on the outside of the sheath and bored through to the inside, the place of entry being marked by a minute globule of dried sap. *Axiagastus cambelli*, Dist., is prevalent throughout the Territory, being present in all stages of development, both in the heads of the palm and on the opening spathes, and when particularly abundant may lead to slight nutfall. The Lucanids, *Eurytrachelus egregius*, Möll., and *Metopodontus bison*, F., feed on the male blossoms and sometimes damage the female buds ; *Cyclommatus margaritae*, Gestro, and *C. speciosus*, Boisd., have also been collected on newly opened coconut spathes. The Cetoniids, *Lomaptera batchiana*, Thoms., *Panglaphyra duboulayi*, Thoms., and *Poecilopharis emilia*, White, have been found feeding on male blossom.

FROGGATT (J. L.). **Coccid Pests of Coffee.**—*New Guinea agric. Gaz.* **2** no. 3 pp. 22–24, 2 refs. Rabaul, December 1936.

The most serious attack of insect pests on coffee in the Territory of New Guinea occurred on one plantation in 1934, when a species of *Pseudococcus* spread from *Erythrina* to *Leucaena glauca* and coffee and soon affected a considerable part of the crop. *Erythrina* in the neighbouring bush, which was heavily infested, was in the direct line of the prevailing winds, which are thought to have considerably influenced dispersion. A small Coccinellid that followed the mealybug into the plantation eventually gave good control. The author outlines H. C. James' methods of preventing ants, which, however, were not plentiful during this outbreak, from gaining access in large numbers

to coffee mealybugs, and of breeding Coccinellids [*R.A.E.*, A **18** 569, etc.]. *Coccus viridis*, Green (green coffee scale) is common on a number of bushes other than coffee. Suitable sprays for the control of Coccids are lime-sulphur or a quick-breaking emulsion of light to medium oil.

LEEFMANS (S.) & AWIBOWO (R.). **Bestrijding van *Brachartona* met Dusturan.** [Combating *Artona catoxantha* with Dusturan.]—*Landbouw* **11** no. 1 pp. 1–20, 1 fig., 4 refs. Buitenzorg, July 1935. (With a Summary in English.). [Recd. June 1937.]

A detailed account is given of further tests in Java against the larvae of *Artona* (*Brachartona*) *catoxantha*, Hmps., on coconut, using the pyrethrum dust already reported on [*R.A.E.*, A **22** 16] and now sold as Dusturan. The dust was applied by means of a portable power duster mounted on a stretcher. A mixture of equal parts of Dusturan and talc was effective, and greater dilution might give satisfactory results. It is essential that the insecticide should be as fresh as possible, and never more than 6 months old. It should be applied when the larvae are half-grown and 5–7 mm. long, as those that survive are then destroyed by parasites. The chief of these is the Braconid, *Apanteles artonae*, Rohw. (*brachartonae*, Rohw.), which is not affected by the dust, as it is in the cocoon stage when the larvae of *A. catoxantha* are in second and third instars.

KALSHOVEN (L. G. E.). **Insecten in versche en in opgeschuurde tengkawang pitten (*Shorea* en *Isoptera* spp., fam. Dipterocarpaceae).** [Insects in fresh and stored Illipe Nuts.]—*Landbouw* **11** no. 4 pp. 146–154. Buitenzorg, October 1935. (With a Summary in English.) [Recd. June 1937.]

Illipe nuts, which are rich in fat and are exported to Europe, are attacked in West Borneo by a number of insects, a preliminary investigation on which is reported here. The species obtained from recently harvested nuts were *Tirathaba ruptilinea*, Wlk., and *Cateremna albicostalis*, Wlk., both in numbers, one example of *Cydia* (*Laspeyresia*) *pulverula*, Meyr., two of *Aegeria nautica*, Meyr., one larva of *Alcides shoreae*, Mshl., and two adults of a Scolytid of the genus *Thamnurgides*. The stored dried nuts were infested by the Pyralids, *Pyralis pictalis*, Curt. (probably recorded for the first time as a pest of stored products in the Netherlands Indies), *Doloessa viridis*, L., and *Ephestia cautella*, Wlk., a Tenebrionid of the genus *Tibolium* and the Anthribid *Araecerus* (*Araeocerus*) *fasciculatus*, DeG. The nuts known in the trade as " large brown " and " small brown " appeared to be the most infested, and *A. fasciculatus* was the most important of the species attacking them. Preparation of the kernels by soaking and smoking did not appear to affect the pests.

VAN DER GOOT (P.). **Biologische grondslagen van de rijstboorder-bestrijding.** [The biological Foundations of Rice-borer Control.]—*Landbouw* **11** no. 11 pp. 473–482, 1 map. Buitenzorg, May 1936. (With a Summary in English.) [Recd. June 1937.]

A summary is given of the biology of the white rice-borer, *Scirpophaga innotata*, Wlk., in Java, including some data obtained since the last paper on this subject was published [*R.A.E.*, A **13** 466].

The aestivation of the full-grown larvae in the underground part of the rice stubble, where they pupate soon after the onset of the rains, is still the cardinal point as regards control. It was observed that a shower of 10 mm. suffices to wet the soil sufficiently to end aestivation, provided that aestivation has lasted at least 4½ months. The adults emerge about 4–6 weeks after the first shower and are on the wing for 10–14 days. In a given district, the local character of the rains may cause differences of as much as a month in the date, giving rise to two or even three distinct flights. Infestation may be prevented under favourable conditions by retarding the time of sowing the seed-beds until the flight of the moths from the stubble is over, which is some 6–8 weeks after the first rain. In the case of locally late rains, the emergence of the late moths must be awaited before sowing, so that sowing may have to be delayed until 1st December. Since 1925, such control under unfavourable conditions has been carried out with complete success in the district of West Brebes over an area of about 85,000 acres where the borer was a very serious pest.

Joosten (J. H. L.). **De stand van de boordervraagstuk in Krawang.** [The Position of the Rice-borer Question in Krawang.]—*Landbouw* **11** no. 11 pp. 484–502. Buitenzorg, May 1936. (With a Summary in English.) [Recd. June 1937.]

In the plain of West Krawang, an area of about 220,000 acres in Java, irrigation works have rendered the dates of sowing and transplanting rice almost independent of rainfall. Most of the seed-beds are sown in November, and the seedlings are planted in nearly all the rice-fields in December and January. This has resulted in a serious increase of *Scirpophaga innotata*, Wlk., the attack in 1935 being catastrophic. Postponement of the date of sowing would seem the only possible measure, but, after discussing the particular conditions in this area, the author considers it doubtful whether any scheme for control there is likely to be successful.

Kroesen (J. C. T.). **Irrigatie-ervaringen op het gebied van de witte rijstboorder-bestrijding in West-Brebes.** [Experiences concerning Irrigation in Connection with the Control of the White Rice-borer in West Brebes.]—*Landbouw* **11** no. 11 pp. 503–509. Buitenzorg, May 1936. [Recd. June 1937.]

Rice in the western part of the regency of Brebes, Java, was severely attacked in the past by *Scirpophaga innotata*, Wlk., especially northwards where, after the rice harvest, large areas are left uncultivated during the entire dry season and thus afford extremely favourable conditions for the aestivation of the larvae. Control by regulation of the date of sowing, and, in one area, of irrigation, has been applied since 1929, and, as a result, no injury of any importance has occurred. In some seed-beds, however, irrigation is started sooner to enable the land to become subsequently available for sugar-cane somewhat earlier. To prevent the development of *S. innotata* in such beds, they are carefully searched and all egg-clusters are destroyed. The costs of this measure, which is completely effective, are borne by the sugar-cane industry.

MILLER (N. C. E.). **Lac in Malaya. Part II. An Account of Attempts to Propagate** *Laccifer lacca* **(Kerr) in Malay.**—*Sci. Ser. Dep. Agric. S.S. & F.M.S.* no. 19, 22 pp., 2 pls., 8 refs. Kuala Lumpur, 1937. Price *Cts* 50.

Following the failure to propagate *Laccifer javanus*, Chamb., in Malaya [*R.A.E.*, A **21** 571], attempts were made to establish *L. lacca*, Kerr, consignments of which were imported from India, on *Pithecolobium* (*Enterolobium*) *saman*, *Cajanus indicus*, *Zizyphus jujuba* and rubber (*Hevea brasiliensis*), but these also failed. An account is given of the work, which was discontinued, as climatic and other conditions in Malaya appeared to be unfavourable to the insect, and of observations made in the course of it. Natural enemies that attacked *L. lacca* in Malaya were *Eublemma amabilis*, Moore, *Tachardiaephagus tachardiae*, How., which, in one instance, parasitised 50 per cent. of the females of the first generation and almost destroyed the second, and *Tetrastichus purpureus*, Cam., which is a parasite of *Tachardiaephagus* as well as of *L. lacca*.

CHEVALIER (A.). **Sur un groupe de plantes insecticides : les** *Stemona* **d'Indochine.**—*Rev. Bot. appl.* **17** no. 186 pp. 136–137, 4 refs. Paris, February 1937.

Brief notes are given from the literature on some plants of the genus *Stemona* that occur in Indo-China and neighbouring countries and from which insecticides are prepared by the natives.

VERNALL (L. J.). **Entomological Research.**—*Rep. Silv. Ent. Burma 1935–36*, pp. 78–94. Rangoon, 1937.

In this report further information is given on the infestation of teak [*Tectona grandis*] by *Xyleutes ceramicus*, Wlk. (beehole borer) in Burma [*cf. R.A.E.*, A **25** 300, etc.]. From preliminary experiments, it appeared that hatching of the eggs depends on temperature and not humidity, although a constant exposure to a humidity of 5 per cent. or less inhibits development. Exposure to temperatures of 104 or 61°F. for a few hours kills the eggs. The incubation period lasted 16 days, and the newly hatched larvae survived for about 4 days away from the food-plant. It has been shown that the life-cycle can be completed in one year, but it normally requires two, and there is consequently often a biennial rhythm in the incidence of attack. The length of the emergence period in different parts of Burma is not yet known. In 1936, the first moths were found in one Division on 14th March (4 days after the sap began rising in teak), and in another they were emerging from 20th March until the third week of April. *Vitex peduncularis* was an alternative food-plant, but the larvae were unable to survive in *V. carbunculorum*.

In an observation plot on a ridge running east and west, the average numbers of beeholes per tree from 1930 to 1935 were 4·46, 1·66, 2·21, 2·86, 0·32 and 0·65, respectively [*cf.* **25** 301]. The average for the six-year period was 2·25 in trees on the northern slope, where moist shady conditions prevailed, and 1·66 in those on the southern one, where hot sun and dry conditions were less favourable for the eggs and

young larvae. The average annual incidence of attack was higher in the larger trees, but when the number of beeholes per unit of volume is considered, it appears probable that all are damaged to the same extent. It was evident from field observations that the larvae can vacate their galleries and make fresh ones, sometimes migrating for several feet to new trees. In experiments in which larvae were extracted from their galleries and placed on the bark, those 2–3 months old rapidly ate away a small portion of the bark, covered themselves with a protective web and subsequently formed a fresh gallery. Older larvae were much more sluggish, and, unless they found a crevice or rough patch of bark, were attacked by ants before they could spin their webs.

Detailed analyses of infestation in the main teak-bearing areas are being carried out. In one plantation, there were 33 beeholes per tree at 14 years of age, and in a naturally regenerated area, 75 per tree at 18 years, these being the highest infestations so far recorded.

Xyleutes ceramicus is parasitised by an Ichneumonid, *Nemeritis* [*tectonae*, Perk.], which must, however, have an alternative host [*cf.* **24** 241 ; **25** 75]. It is thought that this may be a species of *Phassus*, which is polyphagous and infests both teak and *Callicarpa arborea*, but is apparently dependent on a creeper, *Buettneria pilosa*, for its initial establishment. Infestation of teak by this Hepialid rose to a peak in 1931, but has since decreased noticeably, probably owing to a scarcity of *B. pilosa*, which has been cut back vigorously in the last few years. In the Northern Shan States, larvae of *Phassus* were found in *Gmelina arborea*, which they had entered from the same species of creeper. Another borer in teak was the Lamiid, *Apriona swainsoni*, Hope, which is dependent on *Butea superba* for part of its development and can thus be controlled by cultural methods.

Injury to the leaves of teak by *Hyblaea puera*, Cram., and *Hapalia machaeralis*, Wlk., was more severe than in the previous season. In some places, skeletonisation by *Hapalia* resulted in the death of the leading shoots of trees 6 years or less in age. This was followed by a flush of leaves and epicormic branches during the cold and early hot weather, when teak is normally dormant and when the *Hapalia* population usually diminishes considerably owing to lack of food [**24** 241]. Mixed teak plantations and trees in natural forest suffered as much as pure teak plantations, which suggests that it is the state of the undergrowth rather than the main crop and understory that has the greatest influence on the incidence of defoliation. *H. machaeralis* has been successfully bred in the laboratory, and 10 generations have been completed in 274 days. In material collected in December, the prepupal stage lasted for a maximum period of 54 days instead of the usual 2. Large numbers of different parasites have been bred from this species and from *Hyblaea puera* during the present investigation. Field observations showed that heavy rainfall was unfavourable and dry conditions conducive to outbreaks of the latter.

The second generation of *Calopepla leayana*, Latr., seriously damaged *Gmelina arborea* [*cf.* **24** 241] in the Northern Shan States, the beetles persisting in the plantations until November. As the plantations have since been abandoned, work on the beetle is to be discontinued. Adults of *Xyleutes persona*, LeG., infesting *Cassia* spp., were found emerging throughout the year. The larvae moved from one hole to another. Pests of stored material included *Lyctus* sp. in packing cases, and the Bostrychid, *Sinoxylon anale*, Lesne, in tent pegs.

CHU (Joo-tso). **Notes on the Hymenopterous Parasites of the Pine Caterpillar** *Dendrolimus punctatus* **Walker in China.** [*In Chinese.*] —*Ent. & Phytopath.* **5** no. 4–6, pp. 56–103, 20 figs., 49 refs. Hangchow, 21st February 1937. (With a Summary in English.)

Notes are given on 24 species of Hymenopterous parasites of *Dendrolimus punctatus*, Wlk., reared since 1933 from material collected in Chekiang, Kiangsu and Shangtung, *viz.*: *Telenomus dendrolimusi*, sp. n., *Trichogramma evanescens*, Westw., and *Anastatus albitarsis*, Ashm., parasitic on the eggs; *Apanteles changhingensis*, sp. n., *A. ordinarius*, Ratz., *Rhogas spectabilis*, Mats., *Iphiaulax impostor*, Scop., *Glyptomorpha deesae*, Cam., *Rhythmonotus takagii*, Mats., *Cratojoppa okinawana*, Uch., *Phanerotoma flavida*, Enderlein, *Chelonus* (*Chelonella*) *jungi*, Chu, *Phygadeuon latipetiolator*, Uch., *Pristomerus vulnerator*, Panz., *Stenaraeoides octocinctus*, Ashm., *Pimpla* (*Iseropus*) *satanas*, Morley, and *Pimpla* (*Epiurus*) *mencianae*, Uch., on the larvae; and *Xanthopimpla japonica*, Krieg. [*cf. R.A.E.*, A **22** 549], *Theronia atalantae*, Poda, *T. rufescens*, Morley, *Pimpla disparis*, Vier., *P. turionellae*, L., *Brachymeria obscurata*, Wlk., and *Monodontomerus* (?) *dentipes*, Boh., on the pupae. The two new species are described in English as well as Chinese. A list is given of the known Hymenopterous parasites of the various pine moths of the genus *Dendrolimus*, showing their distribution and the species and stage they attack.

DU PLESSIS (C.). **The Occurrence of the Brown and Red Locust in the Union during the Seasons 1934–35 and 1935–36.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 164, 17 pp., 9 maps. (Repr. fr. *Fmg in S. Afr.* Jan. & Dec. 1936.) Pretoria, 1937. Price 6*d*.

The first part of this paper has already been noticed [*R.A.E.*, A **24** 442].

During the season 1935–36, locust breeding in the Union of South Africa was less extensive than in the preceding year, and eggs were laid over an area of 75,000 sq. miles, as compared with 300,000 sq. miles in 1934–35. Control measures were successful, so that damage to crops and grazing was negligible. Swarms of *Locustana pardalina*, Wlk., coming from the Kalahari desert oviposited in the winter of 1935 in parts of the Cape Province, Orange Free State, South-West Africa and Bechuanaland, but the resultant hoppers were successfully controlled by maize-meal poison bait. The season was unfavourable to the building up of the swarms, and the outbreak appears to have been successfully brought to an end. Breeding by *Nomadacris septemfasciata*, Serv., during 1935–36 took place in the eastern part of the Union, where a minor pre-breeding migration from the north occurred in October, in South-West Africa and in Bechuanaland. In spite of partial destruction of eggs by drought in Natal and Zululand, hopper infestation was considerable. Poison bait was used with success against the hoppers, so that this method will be adopted in future campaigns; a Sarcophagid parasite, *Blaesoxipha* sp., caused some mortality among the older ones in Zululand. Flying swarms, however, developed in all the infested areas, and from July 1936 swarms were entering the eastern part of the Union from the north, so that a considerable infestation during the next breeding season is anticipated.

Fisher (R. C.). **Incidence of Attack by the Pin-hole Borer,** *Platypus cylindrus*, **F., in English Ash.**—*Bull. ent. Res.* **28** pt. 1 pp. 1–3, 1 pl., 4 refs. London, March 1937.

The sapwood of an ash log felled in 1935–36 was found to contain numerous insect tunnels, although no external evidence of their presence had been apparent before sawing. From remains of dead beetles in the tunnels, the borer was identified as *Platypus cylindrus*, F., but no living insects were found. The tunnels, which penetrated the sapwood in a radial direction, came to an end some distance from the surface of the sapwood, in which entrance holes were not present ; the outer ends of the tunnels were closed by a plug of wood tissue. From the annual rings of the log, it was evident that the initial attack took place in 1930, when for some reason the growth of the tree was checked, and new wood formed by the stem cambium in the spring of 1931 grew over the entrance holes then present on the surface of the wood. In subsequent years, the insect tunnels became completely overgrown and incorporated with the sapwood of the tree. In Malaya, apparently sound logs are found on conversion to be tunnelled in the heartwood, probably as the result of some similar infestation at some time during the life of the tree.

Compere (H.). **Coccid-inhabiting Parasites from Africa with Descriptions of new Encyrtidae and Aphelinidae.**—*Bull. ent. Res.* **28** pt. 1 pp. 43–51, 3 figs. London, March 1937.

This paper deals with 5 Encyrtids, 2 Aphelinids of the genus *Coccophagus* and a species of *Scutellista*, all of which were obtained from *Ceroplastes* spp. in East Africa by W. B. Gurney during a search for parasites for introduction into New South Wales against *C. destructor*, Newst. [*R.A.E.*, A **25** 11]. *Diversinervus elegans*, Silvestri, (of which *D. meridionalis*, Compere, is a synonym) and *Coccophagus ispingoensis*, Compere, were reared from *Ceroplastes* sp. in Kenya and Uganda, respectively. No significant difference was found between the species of *Scutellista* from *Ceroplastes* in Kenya and specimens of *S. cyanea*, Motsch., from *Saissetia oleae*, Bern. ; it may represent a biological race of the latter, which does not attack *Ceroplastes* [*cf. loc. cit.*]. Descriptions are given of both sexes of *Bothriophryne ceroplastae*, gen. et sp. n., from *Ceroplastes* sp. and *C. destructor*, in Uganda, and of the females of four other new species, *viz.*, *Coccidoxenus ugandensis*, *Coccophagus amblydon* and *Anicetus parvus* from *C. destructor* in Uganda, and *Ceraptocerus inutilis* (which is possibly a hyperparasite) from *Ceroplastes* sp. in Kenya.

Hamilton (A. G.). **The Mechanism of Respiration of Locusts and its Bearing on the Problem of Inhalation of Poison Dusts.**—*Bull. ent. Res.* **28** pt. 1 pp. 53–68, 2 figs., 12 refs. London, March 1937.

The technique used in this study of the effect on locusts of poison dusts acting through the respiratory system, and in determining the size of particles capable of passing through the spiracular openings, as well as the wind tunnel and dusting apparatus used in the experiments, are described. Measurements of spiracles and tracheae of fifth-instar hoppers and adults of *Locusta migratoria migratorioides*, R. & F., and *Schistocerca gregaria*, Forsk., show that particles of dust under

0·053 mm. in diameter can enter all the spiracles, and those under 0·104 mm. in diameter can enter spiracles 1–4 and 10. The presence of particles in the respective spiracles proved that spiracles 1–4 are inspiratory and 5–9 expiratory in function under all conditions, while 10 is expiratory when the locust is flying and inspiratory when it is motionless.

The quantity of cuprous cyanide dust found in the tracheae after an exposure to a cloud of dust for 10 seconds (the time required by a locust to fly through a cloud in the field) was not sufficient to kill the locust and was infinitesimal as compared with the amount accumulating on its exterior. This suggests that external poisons act, not through the respiratory system [*cf. R.A.E.*, A **20** 336–337], but by direct penetration of the integuments or by affecting the nerve system, and that further work on the action of poison dusts should be concentrated on these aspects of the problem.

Lepesme (P.). **L'action externe des arsenicaux sur le criquet pèlerin (*Schistocerca gregaria* Forsk.).**—*Bull. Soc. Hist. nat. Afr. N.* **28** no. 1 pp. 88–103, 2 pls., 4 figs., 20 refs. Algiers, January 1937. **De l'action externe des arsenicaux sur les insectes.**—*C. R. Acad. Sci.* **204** no. 9 pp. 717–719. Paris, 1st March 1937.

Adults of *Schistocerca gregaria*, Forsk., were dusted with a number of poisons in an apparatus similar to that used by Hamilton [*cf.* preceding paper] or enclosed in glass tubes, so that only their anterior parts remained free. The results show that sodium arsenite and arsenate, which are the most effective poisons when applied internally, are also the most toxic when applied externally, and that the toxicity of poison dusts increases with the relative humidity of the air. Thus, dusting with sodium arsenite causes the locusts to die in 24 hours at 20 per cent. relative humidity, in 12 hours at 60 per cent., and in a shorter time at 100 per cent.

Examinations of tracheae of individuals which had been submerged in arsenical solutions or dusted show that the liquids cannot penetrate into the tracheae, and that dust particles are found in them only in parts adjoining the spiracles, which suggests that arsenicals do not act through the respiratory system [*cf.* preceding paper]. The absence of lesions in the sensory nerve cells of dusted antennae shows that arsenicals do not act specifically on the nerve cells.

When arsenicals were fixed to the body of locusts by means of beeswax cells [*cf. R.A.E.*, A **24** 81], death followed in 3–5 and 10–11 days when the poison was applied to intersegmental membranes or to the metanotum, respectively, showing that arsenicals can penetrate through the integuments into the body cavity. This is further supported by the fact that the changes undergone by the blood cells in locusts poisoned by contact or by ingestion are similar.

Boischot (P.) & Drouineau (G.). **Remarques sur l'action de la nicotine.**—*Rev. Path. vég.* **24** no. 1 pp. 5–17, 1 fig. Paris, January 1937.

A brief account is given of the processes employed in the preparation of commercial nicotine sulphate from tobacco in France and of some tests on it, the results of which are tabulated. Experiments on the sulphate in which 200 cc. of solution containing 0·891

per cent. pure nicotine was exposed to the open air for 8 days, to 40°C. [104°F.] for 5 days, and to 110°C. [230°F.] for 1 day showed that 0·0, 0·5, and 2·2 per cent., respectively, of the nicotine was liberated. This figure rose to 7·8 when the solution was evaporated to dryness in a water-bath, to 14 and 26·9, respectively, when it was exposed to the air for 8 days with the addition of 5 per cent. soap or 1 per cent. sodium carbonate, and to 12·3 and 16·6 when it was exposed to 40°C. for 5 days, and 16·6 and 51·6 when it was exposed to 110°C. for 2 days, with the same additions. Evaporation of the two mixtures raised it to 33·1 and 96·5.

In a test in which 100 cc. solution containing 3·5 per cent. commercial nicotine sulphate (1·782 per cent. pure nicotine) was absorbed by filter paper and left overnight until evaporation was complete, the percentage of nicotine liberated was 8. The addition of 5 per cent. soap and 1 per cent. sodium carbonate raised this to 39 and 99, respectively. The larvicidal action of these liquids was tested by spraying larvae of *Acrolepia assectella*, Zell., placed on filter paper. The addition of 2 per cent. sodium carbonate to a 2 per cent. solution of the sulphate, which by itself had no action after 5 hours, gave complete mortality after 15 minutes. When soap was added, complete mortality was obtained in 3 hours.

In an investigation of scorching of plants by these mixtures, beans were sprayed at 8 a.m., and evaporation in the sun was permitted (the maximum temperature 1 ft. above the soil was 33°C. [91·4°F.]). The nicotine sulphate alone caused no scorching at concentrations of 0·015–0·031, slight scorching at 0·062–0·25, and marked scorching at 0·5–2·0 per cent. The addition of 5 per cent. soap considerably increased this effect, scorching being serious at the highest concentrations, but the increase was less marked when sodium carbonate was added. The same relative effect was preserved when spraying took place at 6 p.m., but scorching took place only at the higher concentrations. As neither soap nor sodium carbonate caused any scorching when applied alone in the sun at a concentration of 5 per cent., the increased injury must have been due to the nicotine liberated.

In a test of the absorptive properties of soil, 3 lots of 50 gm. of calcareous clay soil, separated by filter paper, were placed in a tube 14 cm. long, and 350 cc. of sulphate solution, containing 3·605 gm. pure nicotine was poured into the top. The soil retained 125 cc. of the liquid and 81·5 per cent. of the sulphate, while only 0·67 gm. nicotine was not taken up by it and passed through with the surplus liquid. The effect of water on this fixation was tested by pouring 5 lots of 225 cc. distilled water into the tube, and 96 per cent. of the nicotine was washed through, in decreasing amounts. Nitrification of nicotine takes place fairly rapidly ; of 20 cc. nicotine sulphate containing 87 mg. nitrogen that was placed in 500 gm. soil and left at laboratory temperature for 4 months, 87 per cent. was transformed into nitric acid. Germination of cabbage seeds was not markedly affected by the presence in the seed-boxes of 10 thicknesses of filter paper soaked in nicotine sulphate solution at concentrations of 0·25 per cent. or less (higher concentrations being harmful), and the effect of the nicotine was still slighter in open soil.

The authors conclude that the addition of sodium carbonate to a nicotine sulphate spray causes a rapid, almost total, liberation of nicotine, thus increasing its immediate insecticidal effect, but decreasing its period of efficiency, and that, at normal rates, the increase in scorching of plants that are sprayed in the evening is

insignificant. Depositions of nicotine solutions in the surface soil are not retained, are rapidly nitrified and do not affect germination under normal conditions.

TROUVELOT (B.), DIXMERAS (—), GRISON (—) & LACOTTE (—). **Remarques sur les rapports biologiques entre le doryphore et diverses variétés de pomme de terre.**—*Rev. Path. vég.* **24** no. 1 pp. 32–38. Paris, January 1937.

Further particulars are given of investigations on *Leptinotarsa decemlineata*, Say, on potato in France, a preliminary account of which has already been noticed [*R.A.E.*, A **24** 470]. It was shown that, apart from the factor of age, the adults concentrated on plants with the greatest vegetative growth. When 75 per cent. of the foliage was removed, infestation was reduced by only 25 per cent., but when 90 per cent. was removed, it was reduced by 90 per cent. In the presence of several varieties, infestation tended to be greatest on plants with the greatest leaf development and on those in full vegetative activity. Young plants proved attractive, however, in spite of their small size, especially for oviposition, although adults were more numerous on larger plants. It thus appears that plants that are already fairly developed at the time of the spring migrations and are still attractive during the oviposition period will be the most heavily infested by larvae. Oviposition may last a month or more, and then different varieties are visited in turn. The existence of varietal attraction, apart from vegetative factors, is not excluded.

FRAPPA (C.). **Note biologique sur** *Brithys crini* **Fab. noctuelle nuisible à diverses Amaryllidacées de Madagascar.**—*Rev. Path. vég.* **24** no. 1 pp. 39–42, 9 refs. Paris, January 1937.

Brithys crini, F., all stages of which are described, attacks plants of the genus *Crinum* in Madasgascar, where it is indigenous. The synonymy of this Noctuid is reviewed, and notes are given on its bionomics. At Tananarive during the cold season, the egg, larval and pupal stages lasted 7–8, 29–33 and 13–14 days, respectively; these figures are compared with those recorded from Malaya [*R.A.E.*, A **13** 550].

MATTRAS (H.). **Observations sur les invasions de la mouche des fruits (*Ceratitis capitata* Wied.) dans les vergers du midi de la France.**—*Rev. Path. vég.* **24** no. 1 pp. 43–47. Paris, January 1937.

During recent years, *Ceratitis capitata*, Wied., has caused considerable, but intermittent, damage to fruit, especially peaches, apricots and pears, on the Mediterranean coast and in the Rhône valley in France. Observations made in an orchard at Perpignan in 1933, where peaches planted in 1926 were grown, showed that the fruits of 200 trees under which the soil was hoed each month were infested only at harvest and not more than 10 per cent. were damaged, while almost all the fruits of 400 trees beneath which asparagus was grown were infested. In 1934, trees beneath which artichokes were grown gave only 30 per cent. sound fruit, while others on bare soil gave 98 per cent. Similar results were obtained when potatoes were cultivated beneath the trees. In 1935, infestation was slight, but was most severe on trees situated

near to a hedge. It was controlled by burning the hedge. *C. capitata* was bred from damaged fruit in pots containing soil or sand and kept at a temperature above 40°C. [104°F.]. Cultural practices recommended for control include the destruction of all natural or artificial shelter, the avoidance of supplementary crops beneath the trees, and extensive soil irrigation for 10–20 minutes, followed by thorough hoeing when the soil is sufficiently dry, to destroy the pupae.

MATTRAS (H.). **Note sur une chenille qui détruit les bourgeons du pommier dans les Pyrénées-orientales.**—*Rev. Path. vég.* **24** no. 1 pp. 48–49. Paris, January 1937.

Observations in an orchard in the Pyrénées-orientales in 1936 showed that considerable damage was caused to buds of apple by *Chrysoclista* (*Blastodacna*) *atra*, Haw. [*cf. R.A.E.*, A **23** 140]. The tissues surrounding the damaged buds were broken, and every dried bud contained a larva that mined beneath the bark not more than a centimetre from the bud in any direction. Infested trees were recognisable by their bare branches; trees 4–5 years old were more susceptible than older ones. Arsenical treatment gave no control of *C. atra*, which is not widespread in this region. Infested branches should be burnt.

BOUHÉLIER (R.). **La lutte contre *Pseudococcus citri* Risso dans la région de Casablanca.**—*Rev. Path. vég.* **24** no. 1 pp. 50–56. Paris, January 1937.

In experiments against *Pseudococcus citri*, Risso, on oranges and *Myoporum* at Casablanca, Morocco, various sprays of kerosene emulsion were effective when applied at high pressure to fruits and the extremities of branches. No appreciable damage was caused to *Myoporum*, and scorching of oranges, which was not serious, was mitigated by spraying the trees with water 1½ hrs. after treatment, the insecticidal effect being unimpaired. Trees thus washed were less susceptible to the mid-day sun after one month than unwashed trees, but more so than untreated ones. The formation of drops on the fruit caused some skin-injury. These sprays were fairly effective against *Chrysomphalus dictyospermi*, Morg., which also occurred on the oranges, killing an average of 90 per cent. of the nymphs and 75 of the adults.

Notes are given on Coccinellids predacious on *P. citri* and their utilisation [*cf. R.A.E.*, A **23** 302]. In one plantation, the Encyrtid, *Anagyrus bohemani*, Westw., parasitised large numbers of the mealybug on leaves and fruit, but not of those in sheltered situations. It was easily reared in the laboratory, developing in about 35 days. A Pteromalid, *Pachyneuron coccorum*, L., which was reared at the same time, was presumably a hyperparasite attacking *A. bohemani*.

RAUCOURT (M.) & TROUVELOT (B.). **Essais de poudrages au fluosilicate de baryum contre le doryphore.**—*Rev. Path. vég.* **24** no. 1 pp. 57–69. Paris, January 1937.

An account is given of experiments in France in 1935 on the use of barium fluosilicate dusts against *Leptinotarsa decemlineata*, Say, on potato [*cf. R.A.E.*, A **24** 86]. The results are tabulated and illustrated by graphs. Dusting was carried out on plots of 25 sq. m. each

and on third instar larvae weighing 80–100 mg. each that had been tested for vitality on the previous day, 25 of which were placed on selected plants on each plot. After treatment, they were examined daily for 4 days. Three of the dusts tested consisted of 80, 60 and 40 per cent. barium fluosilicate, respectively, and kaolin, while a fourth, approximating to a commercial product, contained 20 per cent. fluosilicate, 79 per cent. talc, and 1 per cent. impurities. Applied at the approximate rate of 22½ lb. per acre, the first three gave 79, 62 and 71 per cent. mortality, respectively, in 4 days, whereas lead arsenate dust (10 per cent. As) gave 94 per cent. at about the same rate of application. Laboratory tests did not confirm these results, possibly owing to the difficulties of application at such low rates. At the approximate rate of 36 lb. per acre, all the dusts were practically as effective as the lead arsenate, but caused a more rapid mortality. The 20 per cent. dust was not inferior to the others, but a concentration of 40 per cent. should be used if the insecticidal action is to be lasting. In no case did these dusts injure the plants. An experiment in which larvae placed on potato were dusted at the rate of 36 lb. per acre and immediately removed to the laboratory without being allowed to eat contaminated foliage showed that barium fluosilicate has a marked value as a contact insecticide, at least as compared with arsenicals, 70–80 per cent. dying in three days. Adults were unaffected by the dust at the rate of 22½ lb. per acre in similar circumstances. The whole subject of barium fluosilicate dusting, however, is subject to further research, especially as to meteorological influences, for a wet, cold year might greatly reduce its effectiveness.

Mesnil (L.). **Un traitement efficace contre la cécidomyie du choufleur.** —*Rev. Path. vég.* **24** no. 1 pp. 70–77. Paris, January 1937.

Experiments were carried out in 1935–36 in northern France on the control by nicotine sprays of *Contarinia nasturtii*, Kieff. (*torquens*, de Meij.) [*cf. R.A.E.*, A **19** 274], which of recent years has severely infested cauliflower, sometimes rendering 99 per cent. of the crop unfit for marketing. Approximating to commercial conditions, three sowings were set, followed by three transplantings on 11th and 25th May and 6th June, respectively. Harvesting began on 21st July. Tests were made with three sprays, containing 1·2 parts nicotine sulphate to 5 of sodium sulphoricinate, 1 part pure nicotine to 5 of sodium sulphoricinate, and 1 part nicotine, 7·5 of oleic acid and 5 of commercial volatile alkali, respectively, in 1,000 parts of water. These were applied by means of a portable apparatus twice a week from 13th May to 16th July at the rate of 1½ pints to 30 plants of average size. The results showed that, whereas unsprayed controls suffered 77–83 per cent. injury, the attack on sprayed plants did not exceed 0·29 per cent., and in these few cases, the damage was done before transplanting. In practice, not more than 10 applications would be necessary, at slightly longer intervals than those in the tests. The cost of treatment was 2½ per cent. of the market value of the plants.

Petherbridge (F. R.) & Stapley (J. H.). **Cutworms as Sugar-beet Pests, and their Control.**—*J. Minist. Agric.* **44** no. 1 pp. 43–49, 2 pls. London, April 1937.

An examination of several fields of sugar-beet in eastern England in 1935 showed that practically the whole cutworm population was

composed of larvae of *Euxoa segetum*, Schiff. Damage and newly-hatched larvae were first observed on 29th June, and, within a week, larvae not exceeding ½ in. in length were found in several different localities. During the season, they were abundant and widespread, particularly in July, when they severely damaged late-sown beet, frequently killing it. As many as 6 larvae sometimes occurred on one root, and fresh damage could still be found in attacked fields at lifting time. In 1936, no damage to sugar-beet by larvae of *E. segetum* was observed, though adults were abundant in some districts. Of large numbers of moths collected at night in a field on 30th June and 3rd July, *Feltia* (*Euxoa*) *exclamationis*, L., *E. segetum*, *Agrotis pronuba*, L., and other species comprised 50, 30, 5 and 15 per cent., respectively. Larvae of these species had not previously been found in sugar-beet fields in the neighbourhood. Examination of large quantities of sugar-beet at the factory showed only slight injury. *F. exclamationis* was not bred from any caterpillars collected in the field.

Larvae of *E. nigricans*, L., which has not previously been regarded as a serious pest of sugar-beet, damaged seedlings severely in 1936 and was probably responsible for similar damage in 1930 and 1935. On 14th May, sugar-beet seedlings were being eaten off at ground level and large holes were being made in the side of older plants by large numbers of cutworms that had been active for at least 10 days. Infestation occurred principally in fields where potatoes, carrots or celery had been grown in 1935. The cutworms disappeared by the middle of June. In the laboratory, pupation began on 13th June, but only a few pupae were found in the field. From about 100 larvae collected in one district, 67 adults were obtained, all of which were *E. nigricans*, and cutworms damaging young beet in other parts of the eastern counties, all proved to be of the same species, with the exception of two individuals of *E. tritici*, L.

In a field where damage by *E. segetum* was first noticed on 29th June, a slightly moistened mixture of ⅓ lb. Paris green and 10 lb. bran was applied respectively to each of two ¼ acre plots by spreading broadcast and applying carefully along the rows. On 15th July, the numbers of cutworms per 40 plants in an unbaited area and on the two treated plots were 68, 24 and 14 and on 22nd July, 21, 5 and 0, respectively. On 23rd September, there was about 1 full-grown cutworm to every 3 beet plants on the unbaited area, and fresh damage was evident. No cutworms or fresh damage could be found on either of the treated plots. The same bait was spread broadcast in the middle of May in a field 14 acres in extent in which *E. nigricans* had destroyed nearly all the young beet plants and in which a second crop had just been sown. On a part of the field that had received 40–50 lb. bait per acre, the numbers of live and dead larvae found 3, 11, and 18 days after baiting were 33 and 20, 21 and 24, and 6 and 22, respectively. This part of the field produced a satisfactory crop. There were large gaps in the crop in a part of the field that had received only 20–25 lb. bait per acre. In an adjoining field that was not treated, the second crop was completely spoiled by cutworms. In another field, treated on 18th May after re-sowing, 76 per cent. of the larvae were killed 9 days later. Probably the first sowing could be protected by baiting early. Moistened mixtures of 1 lb. Paris green and 20 lb. dry molassed pulp, 1 lb. sodium fluoride and 20 lb. dry molassed pulp, and 2 lb. sodium fluoride, 20 lb. bran and 1 lb. treacle, tested on small plots on 4th July, gave respectively 81, 48 and 82 per cent. kill in 5 days. Bran is

probably the better carrying medium because of its greater bulk. Hand picking of the larvae is useful for small areas or to supplement baiting.

Bazan (R.) & Köhler (P.). **La Cochinilla** *Neocoelostoma xerophila* **Hemp. productora de "laca."** [The Coccid, *N. xerophila*, a Producer of Lac.]—*An. Soc. cient. argent.* **123** no. 3 pp. 97–112, 4 pls. Buenos Aires, March 1937.

All stages and the scale of *Neocoelostoma xerophila*, Hemp., are described. This Coccid appears to be common on *Acacia farnesiana* in northern Argentina and produces a substance similar to the gum lac produced by *Laccifer* (*Tachardia*) *lacca*, Kerr, in India. As a rule, the scales are found in a fork between branches or at the base of the thorns.

Papers noticed by Title only.

Golding (F. D.). **Further Notes on the Food-plants of Nigerian Insects. IV.**—*Bull. ent. Res.* **28** pt. 1 pp. 5–9. London, March 1937. [*Cf. R.A.E.*, A **23** 544, etc.]

Jepson (W. F.). **Observations on the Morphology and Bionomics of** *Serica brunnea*, **L., with Notes on Allied Chafer Pests. Part I. The Morphology of** *Serica brunnea*, **L.**—*Bull. ent. Res.* **28** pt. 1 pp. 149–165, 8 figs., 28 refs. London, March 1937.

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